SCIENCE.

FRIDAY, JANUARY 25, 1884.

COMMENT AND CRITICISM.

MR. A. GRAHAM BELL's recent communication to the Washington philosophical society, discussing various common fallacies as to the dumbness of deaf children, is a clear and convincing presentation of the arguments for teaching deaf children with no defects in their vocal organs to speak, though they cannot learn as other children do, being unable to hear. To teach lip-reading is certainly practicable in many such cases, if not in all; and therefore it would seem that the attempt ought to be made in every case, to the exclusion of a purely conventional language of signs. Mr. Bell points out the real nature of the problem and its difficulties, indicating, among other things, the importance of the context to the deaf lip-reader in distinguishing words which look alike to his eye, such as *pat*, *bat*, *mat*, because he cannot see the workings of all the organs of speech, and laying emphasis on the fact that even very imperfect speech, if intelligible, is far better than no speech at all.

After reading his communication and the discussion which followed, especially his answer to objections and to arguments for the use of signs in teaching the deaf, we must give full assent to all the essentials of his arguments. Any student of linguistic science realizing the importance of a clear conception of the nature of language, and the value of careful phonetic analysis, will find this paper of interest, and must hope for the spread of such views as those here expressed, in the interest of his own studies as well as of the deaf-mutes, who may yet be taught to speak.

THERE is an entertaining field for some linguistic geographer to cultivate in this country by mapping out the distribution of the various kinds of town, county, river, and other names according to their origin and derivation. The great bulk of newer names has no significance in this regard, being purely local, personal, and commonplace; but places of older date often give an interesting clew to the former homes of their first settlers. Distinctively English names have but a slight penetration beyond the Atlantic coast, except in Canada. The French follow a well-marked line up the St. Lawrence and down the Mississippi. Dutch and German names give local color to the Hudson valley and parts of eastern Pennsylvania; and the Spanish have a broad occurrence in the far south-west. Indian names occur everywhere, from the euphonious Minnesota to the doubtful Tuscaloosa and the abrupt Oshkosh. The proper sorting-out of these last would require a rarer knowledge, as it would give more valuable results than the rest of the work; but all might be graphically shown with great clearness.

THE hydrographic office of the U. S. navy department has issued the Pilot chart of the North Atlantic for January, on which are given the latest reported positions of floating wrecks. The number of such wrecks which were reported as seen from Nov. 22 to Dec. 25, and of which the positions are charted, is twenty-two. Nine of them were along the eastern coast of the United States, from Maine to Cape Hatteras; seven were on the Atlantic, in the track of vessels going from the United States to England; two were near the West Indies; and three off the coast of Spain. Some months ago the more or less impracticable suggestion was made, of employing naval vessels to chase these dangerous obstructions, and blow them to pieces. The navy department has done good work in locating their positions; but, on account of the winds and ocean-currents, the results can only have value for a short time. It is desirable that some

way should be invented of doing away with this additional danger of ocean travel.

It is not uncommon to hear complaints of the methods of teaching geography in our lower schools. The faults most frequently mentioned are, that the beginning is not made properly; that there are too many lists of places committed to memory; and that the teaching is too lifeless, and is not made real enough by illustration and description apart from the text-book. The first error can be easily corrected by adopting the German method of instruction, where, instead of beginning with the definitions of meridians and parallels, that are so often found misplaced on the opening pages of our text-books, the pupils first study the arrangement of the schoolroom, then of the playground, next the geography of the town and of the surrounding country, and thus learn the meaning of the maps from which they afterwards study about the more distant parts of the world.

But this does not go very far. After laying the proper foundation, is there any way of learning geography, except by committing to memory the names and relative positions of the many mountains, rivers, capes, bays, lakes, cities, and towns, that give features to the earth? Detail may, of course, be carried too far, if a precise knowledge of distant, and to us unimportant, countries be required; but for the average scholar of this country, who should become well acquainted with the geography of North America and Europe, there is no easy path, no royal road, over the broad, rough field of fact that he must cross. We fancy, therefore, that the second criticism touches, not a fault, but a difficulty inherent in the study. Names and positions of places must be learned; but, as books of moderate cost can give very little more than the barest mention of them, the study is apt to become lifeless, and to degenerate into the learning of dull words from a dead map, unless the teacher averts this unfortunately common result, and enlivens the work by instruction beyond the text-book. This, however, is more than we have a right to expect from the overworked and underpaid teachers in the lower schools, for it is no easy task. It demands much reading in many books; it requires illustration by numerous maps, photographs, and diagrams, far beyond the reach not only of the teacher, but of the school board as well. In short, the desirable, the ideal teaching of even so commonplace a subject as elementary geography is an expensive art, requiring much study, high skill, and an extensive outfit.

It is now recognized that the successful teaching of chemistry, physics, and natural science, needs that the teachers of these branches shall know them by practical, experimental, observational work. A fair application of the same principle would require that the teacher of geography should have travelled; but how far are we now from so desirable an end! It is safe to say, that, of all the teachers of our common schools, not one-quarter have seen an ocean, a harbor, or a high mountain, and not one-twentieth of them have had any personal acquaintance with the foreign countries that they have to describe. Under these conditions, it is certainly no wonder that the study of geography becomes so often a tiresome exercise of unintelligent memory; and it cannot be otherwise, without a cost that few school boards can allow.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Naval officers and the coast-survey.

IN your issue of the 11th you refer editorially to the proposition contained in the report of the secretary of the navy for 1883, to transfer all national work connected with the ocean, and conducted by other departments, to the control of the navy department; and in a subsequent paragraph you make some criticisms upon the character of the work performed by navy officers in the coast-survey. The question as to whether the navy or the treasury department shall control the work, I do not propose to discuss; but I must enter my protest against the assertion in a journal like *Science*, which goes forth to the world as authority, that the "work which these [navy] officers perform is routine, the plans and methods for which have been devised and developed by civilian experts," and to the assertion contained in the phrase, "the present method of employing our superfluous navy, under the intelligent supervision of

civilian experts."— To answer these points in order, I will say, first as a matter of history, that the 'plan' of the coast-survey was compiled over forty years since by a mixed board composed in part of navy officers. This plan was legalized by Congress in 1843–44, and has been mainly in force ever since; though some modifications have necessarily been made by the judgment and experience of the eminent men who have held the offices of superintendent and principal assistants. By the plan referred to, it was made the *legitimate* duty of officers and men of the navy to execute the hydrographic part of the work; and to them has ever since been assigned the bulk of that work, except during the few years when the civil war and the subsequent scarcity of officers made it impossible to do so. That period (i.e., from 1861 to 1871) developed a good many civilian hydrographers who have no superiors in the world, but nearly all of these resumed their more legitimate work upon the return of navy officers to the survey. The *methods* of hydrography are the growth of hundreds of years, and have been contributed to by the seamen of all maritime nations; and, while the inventors of a good many instruments and special methods are known, it would be exceedingly difficult to trace the *system* to its source. The 'tricks of the trade,' so to speak, have been handed down from one to another with gradual improvement, — as a rule, too slow to give any definite point from which that improvement can be shown, though during the forty years of its existence the coast-survey has vastly improved the character of its work; but probably the improvement in its means (i.e., the introduction of steam-propelling power, etc.) deserves a good deal of the credit for improved methods. While civilians have had a share in the development, it is a long way from the fact, to ascribe all to them, as it is to assume that hydrography is a work which does not require skill, judgment, and care. Those who think the last have never worked in intricate waters. The officers engaged upon the coast-survey have been so assigned because it was a part of their regular duty, and not because 'superfluous.' Having had for five years the privilege of nominating the officers to be employed upon the coast-survey, I can speak with some authority. Officers were chosen strictly for their qualifications; and often, had it not been for the great interest taken in the coast-survey by the successive chiefs of the bureau of navigation, the officers selected would not have been spared from other duties. That all work of the coast-survey is supervised by the superintendent, an expert of high order, is an undoubted fact; but his instructions to hydrographers, unless he has some special object in view, simply assign geographical limits, but do not prescribe methods, a general printed manual covering all that is required in the latter. The work, after completion, has of course to pass the rigid scrutiny of the superintendent; but the same is the case with all other work. To this extent the work of navy officers may be said to be 'supervised by civilian experts,' but no farther. In 1873 several navy officers, who without previous experience were ordered to the coast-survey, placed themselves for a short time under the instructions of civil assistants, who had been doing their work for some years; and all of them freely and gratefully acknowledge the assistance they received. I am free to acknowledge obligations of a similar character, — of many a *point* received from my valued civil associates during the Darien Canal expedition of 1870. Nautical surveying has always been taught theoretically at the Naval academy; and as much practice as possible has generally, though not always, been given. Furthermore, nautical surveying and navigation are very near cousins, so that all the instruction needed to make a navigator a surveyor is to give him what I have called the 'tricks of the trade;' and these are being handed down by officers as they have been by their predecessors.

EDWARD P. LULL,
Captain U.S. navy, late hydrographic inspector U.S. coast geodetic survey.

[The plan of organization of the coast-survey and the plan of work of the survey are quite different things. It is the duty of the chief of the survey to arrange and supervise the latter. That the scope and character have been extended since its organization in accordance with the views of the chief is beyond question. While from the above letter it might be inferred that the nautical work of the coast-survey is confined to marine surveying in its older sense of locating rocks and shoals, and determining the boundaries of courses of the navigable waters by time-honored methods, yet from the publications of the coast-survey, and from other sources, we had gathered that the study of ocean physics, and of the conformation and character of the ocean bottom, together with the different forms of marine life, had formed, of recent years, an important part of the work of the survey, and that it was carried out in accordance with the plans of the chiefs of the survey, and by the methods devised and developed by them and by the two Agassizs, Pourtales, Thompson, Milne-Edwards, and many other eminent specialists, modified in minor details by the circumstances of each case.

It is an error to suppose we regard the employment of naval officers in this work unfavorably; for, on the contrary, we think it highly desirable that they should be employed in this routine work of collecting data and material for discussion and study by specialists; and their skill, judgment, and care, their knowledge of organization and discipline, and their close adherence to instructions, render them extremely useful. It is wise, also, that, in the present reduced condition of the navy as to ships, and its overcrowded condition as to officers, the secretary should find employment for this superfluity in the coast-survey, the fish-commission, the geological survey, the national museum, as instructors in our colleges, and as assistants in special researches. Such employment cannot but result in benefit to the navy, and assist in the advancement of science.

Yet we have still to be persuaded that it will promote the efficiency or the economy of the scientific organizations of the government if they are transferred from the supervision of the present expert civilian heads to that of the officers of the navy.]

Italics for scientific names.

I agree with the editorial remarks under this heading in *Science*, No. 49, that the proper mission of italics is for 'emphasis, or as catch-words;' and their use for scientific names of animals and plants is, it seems to me, — contrary to the opinion conveyed editorially, — of great practical utility, especially in indexing, or in searching the pages of an article or memoir for references to particular species that may be under treatment. Italicizing such words makes them 'catch-words,' and gives great facility in discovering incidental reference to species, the eye quickly catching the italicized name, and as quickly recognizing whether it is the one sought. Considering scientific names as 'a simple convenience,' and as having no higher value, their use is so necessary as

a 'handle to facts,' or as names of objects of which we have to speak, it seems desirable to have them so typographically distinguished that their presence on a printed page will quickly catch the eye as guide-posts to the subject of the immediate context.

J. A. ALLEN.

Cambridge, Mass.

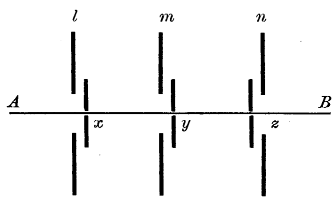
[The editor has yet to be convinced that typography should be moulded to suit the purposes of an indexer.]

Eating horns.

Indians eat the horns of the deer when in the velvet. One day on the Sioux Reservation, in Dakota, a deer was killed near camp, and brought in entire. At sight of it, Pahlani-ote, a Minneconjon of some fifty years, dropped his usual statuesque attitude, knocked off the horns, and, seating himself by the fire, began at the points to eat them, velvet and all, without cooking, as if they were most delicious morsels. The others of the party looked on as if they envied him. They said they always ate them so. S. GARMAN.

Radiant heat.

In a letter to *Science* of Dec. 21, 1883, Dr. Eddy has endeavored to show that I was mistaken in thinking that his proposed arrangement for proving that radiant heat is not subject to the second law of thermodynamics would not work.



I can most easily explain how Dr. Eddy is again mistaken by referring to my diagram which he reproduces in his letter. Dr. Eddy says that *every* time the door z is opened two quantities of heat pass into the region B, one of which had originally come from A, and the other from B. I had assumed that the occasions when it opened to let heat that had come from A pass were different occasions from those when it opened to let that from B pass. I assumed this, because I could see no way of getting the heat that had come from B back again through z in the same direction as it had come out, except by a reflection from the back of y; and of course that required y to be shut at the time of reflection, so that this heat could not reach z at the same time as any heat that had originally come from A. I have been unable to think of any method of getting the heat from A and what had come from B to travel *simultaneously* in the same direction; and I am inclined to think, that, if this were possible, Dr. Eddy's doors, etc., would not be required to enable A to radiate more heat to B than B does to A. This supposed arrangement might, as far as I can see, go on working continuously, returning the heat to B, and simultaneously transmitting that from A; for this seems to me to be what Dr. Eddy postulates as possible.

If the two quantities pass into B through z in two different directions, then two other quantities will escape from B in these two directions, and B will be in exactly the same condition as it would be according to my hypothesis that they passed into B at different times.

Dr. Eddy confesses to being unable to see how to accomplish what he postulates with my arrangement of screens and apertures; and I believe that the only reason he is unable to do so, and imagines that his own proposed whirling tables would do so, is because my arrangement is so much simpler than his, that it is almost impossible to be misled as to where and when the heat comes in and goes out; while, with his arrangement, he has so many holes that it is almost impossible to keep before one's mind all that is supposed to be going on. I cannot see how my simple arrangement is less general than Dr. Eddy's complicated one, as it seems to me that a multiplicity of holes cannot be of any real use, while they produce very serious complication; and, except in the number of holes, I think Dr. Eddy's arrangement only differs from mine in that his supplies a mechanism for opening the apertures, which, of course, has nothing to do with the question. If Dr. Eddy will explain how he manipulates so as "to bring the heat coming from A into a position such that it would be in readiness to pass into B at the same time," *and in the same direction*, "as the heat which originally came from B is returned to B," and does not rest upon the authority of Professor Gibbs that his arrangement does so, then I will agree that he has invented an arrangement by which the second law of thermodynamics may be cheated. GEO. FRAS. FITZGERALD.

40 Trinity college, Dublin,
Jan. 7, 1884.

Professor De Volson Wood makes statements in his letter published in your issue of Jan. 11 which appear to me unsupported by facts. Were your columns open to a lengthy discussion, I should like to show this in detail. Suffice it to say, that in his reference to Mr. Fitzgerald's construction he entirely overlooks the difference between radiant heat, which must be moving along given lines in a determinate direction, and other heat. The heat referred to as 'entangled in the space $m\ n$' is radiant heat alone. I have definitely traced its path, and shown that it does not move as Professor Wood states. Instead of regarding this fact, he has attributed to it the properties of heat as ordinarily existing in matter.

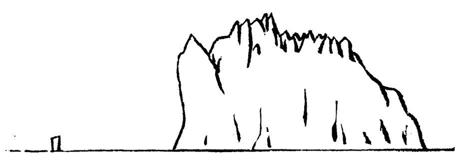
Professor Wood also refers to his papers in the *American engineer*, etc. The only point in that somewhat lengthy and personal discussion upon which I understand Professor Wood to finally insist, he republished in the *Journal of the Franklin institute* for May, 1883. In my reply in the same journal for June, 1883, I showed the fallacy of his objection. So far as I know, Professor Wood has taken no notice of that reply, and now completely ignores it. I may say that the proof he relied upon was of this nature. He proposed a certain construction or process (differing essentially from mine) for dealing with radiant heat, and one which would not accomplish the end sought. He then showed that his construction was a failure, and concluded that mine would therefore fail also, — a method of reasoning which seems to me inconclusive, to say the least. And now Professor Wood says that Mr. Fitzgerald's construction is 'conclusive.' All it is conclusive of is, that it will not accomplish the end which I have proposed: we all agree that it will not. I have shown, however, that my proposed construction differs from both in just those particulars necessary to make it accomplish the end sought.

It is unfortunate that the velocity of radiant heat is such as to render experimental verification a matter of great difficulty. H. T. EDDY.

A NEW VOLCANO ISLAND IN ALASKA.

RECENTLY the newspapers have contained references to the rise of a new volcanic island near Bogosloff Island in the Aleutian chain. Bogosloff itself is believed to be a recent development. Possessing some unpublished material and some sketches bearing on this topic, it has been suggested that a *résumé* of the subject would not be without interest for the readers of *Science*.

The island of Ioanna Bogoslova (St. John, the theologian), or Agáshagok of the Aleuts, is commonly known by the shorter name of 'Bogosloff' to the white residents of the region. Owing to its isolated and remote situation, it has been rarely visited, and hence is less widely known than other modern volcano-islands. It is, however, one of the few instances of the sudden and violent formation of land in the sea which have been witnessed in historic times. It is situated in latitude 53° 58′, and longitude 168° west, approximately some forty-two miles west of the northern corner of Unalashka Island of the Aleutian chain. At the

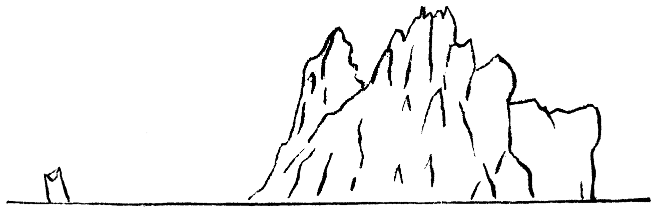


S N. by E., 10 miles.

FIG. 1.

NOTE. — 'S' is Ship Rock.

time when it was observed by us it formed a sharp serrated ridge, about eight hundred and fifty feet in height, very narrow, the sides meeting above in a very acute angle, where they are broken into a number of inaccessible pinnacles. There is no crater, nor appearance of a crater. The shore-line formed a tolerably regular oval, pointed at the south-east end, having its longitudinal axis trending N. W. $\frac{1}{4}$ W. and S. E. $\frac{1}{4}$ E. by compass, and reaching about three-quarters of a nautical mile in length. The shores are mostly precipitous; but at the south-eastern extremity the waves have accumulated a small spit or pointed bit of beach, of talus, on which in perfectly favorable weather a landing may be had. With the least swell a heavy surf is formed here. Seen through a strong glass at a distance of four miles, it appeared of a light pinkish-gray color, devoid of vegetation or water, and covered with myriads of birds. Less than half a mile north and west from the island is a perpendicular square-topped pillar, about one hundred and fifty feet high, called on modern charts 'Ship Rock.' Less than half a mile north and east from the island is a small rock rising only a few feet above the water. North, east, and south, and

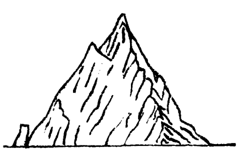


S North, 4 miles.

FIG. 2.

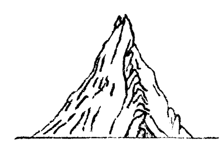
especially east-south-east from the point of the island, scattered breakers were observed, extending less than three-quarters of a mile from shore. The crags of the main island afford the most secure refuge to thousands of sea-parrots, puffins, auks, and divers; and sea-lions (Eumetopias Stelleri) often rest on the talus point. It is visited in spring, if weather permits, by native egg-hunters from Unalashka; but in 1873 several years had passed since any one had been able to make a landing at the proper season. My own party attempted it unsuccessfully in 1872 and 1873.

Such was the condition and appearance of the island in 1873. The outline sketches here given are facsimiles of those taken on the spot as we approached the island from the south-west, and passed south of it eastward toward Unalashka. Their proportions were corrected by horizontal and vertical angles. The wind



S N. by W., 6 miles.

FIG. 3.

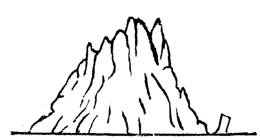


N. W. $\frac{1}{4}$ W., 6 miles.

FIG. 4.

N. W. by W., $6\frac{1}{2}$ miles.

FIG. 5.

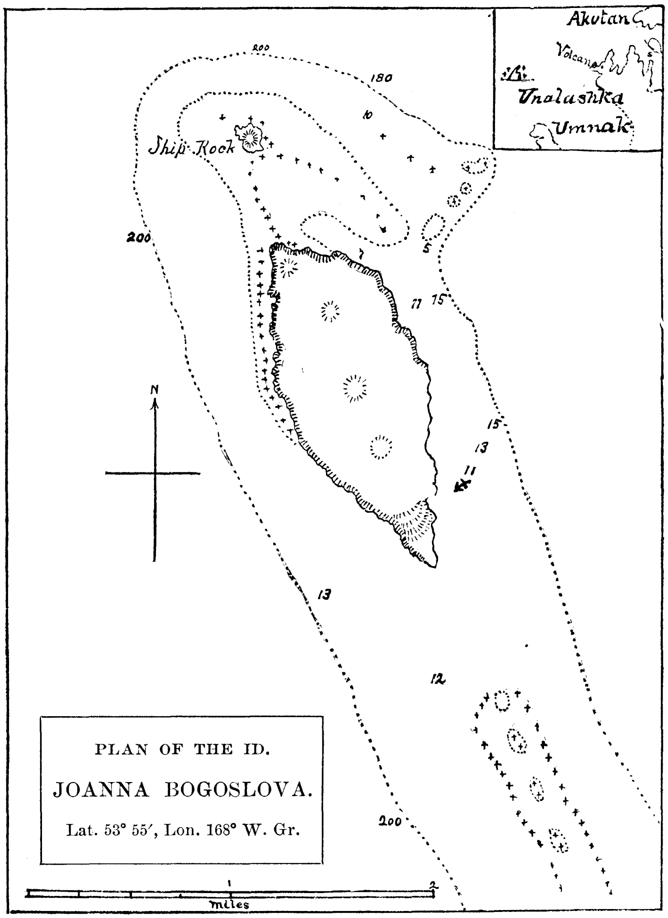


W. N. W., 7 miles. S

FIG. 6.

was light; but there was a heavy ground-swell, which broke on the rocks and the little spit at the south-east end, rendering a landing imprac-

ticable. On the line of the supposed reef, which has ornamented the charts for so many years as connecting Bogosloff and Umnak, three miles from the island, we sounded in eight hundred fathoms without touching bottom. With the exception of a small reef near the north-east end of Umnak, and the rocks within a short distance of Bogosloff, there is water more than eight hundred fathoms deep



PLAN FROM KRUSENSTERN'S ATLAS, 1826.

on all sides of the island. The supposed reef was probably taken for granted by those who saw the white water of a tide-rip which eddies southward toward Umnak Pass on the ebb, in the wake of Bogosloff, as we ourselves observed to occur in a small way. Ship Rock is seen on several of the sketches, standing off to the northward. The earliest information in regard to this island is derived from the map of Krenitzin and Levasheff, prepared from surveys made in 1768–69. No reference to it appears in the abstract of their report which has been preserved for us by Coxe; but a little profile surrounded by rocks is represented off the end of Umnak on their chart, which evidently represents the rock which existed before the present peak was raised. A facsimile of this part of their map appears in the corner of the Krusenstern map on this page.

The next information is given by Cook's voyage in 1778, when an elevated rock, like a tower, was seen Oct. 29, at a distance of twelve miles: 'The sea, which ran very high, broke nowhere but against it.' On Cook's chart it is called Ship Rock, but its identity with what is now known as Ship Rock is uncertain; and at that distance there might have been a number of adjacent rocks or breakers not visible.

We learn from Langsdorff, who visited this region from 1804 to 1806, that, previous to the appearance of the present peak of Bogosloff, a rocky islet had long stood in the same situation, which the Aleuts declared from the time of their forefathers had been a notable resort of seals and sea-lions. This could not have been the present Ship Rock, which is a huge perpendicular pillar.

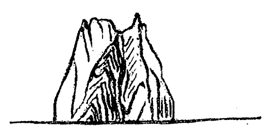
In 1795 the islanders marked a local appearance, as of fog, in the neighborhood of this rock, which did not disperse even when the rest of the atmosphere was perfectly clear. This created much uneasiness, since the natives of Umnak and Unalashka had been used to regard this rock as one of their great sources of food-supply. After a long time, in the spring of 1796, one of the more courageous natives visited the locality, and returned immediately in great terror, saying that the sea all about the rock boiled, and that the supposed fog was the steam arising from it. It was then supposed to have become the abode of evil spirits, and was avoided by every one without exception. The disturbances were accompanied by volcanic activity in the craters of Makushin on Unalashka and others on Umnak Island. The account given by Baranoff and Veniaminoff of what followed may be

summarized, it being remembered that the island is over thirty miles from the nearest land, and about forty from the nearest habitations on Unalashka.

On the 1st of May (old style), 1796, according to one Kriukoff, then the Russian American company's agent at Unalashka, a storm arose near Umnak, and continued for several days. During this time it was very dark, and low noises resembling thunder were continually heard. By daybreak on the 3d of May the storm ceased, and the sky became clear. Between Unalashka and Umnak, and northward from the latter island, a flame was seen arising from the sea, and smoke was observed for ten days about the same locality. At the end of this time, from Unalashka, a rounded white mass was seen rising out of the sea. During the night, fire arose in the same place, so that objects ten miles off were distinctly visible.

Pinnacle Island, W. S. W., 10 miles.

FIG. 7.



Pinnacle Island, N. N. W., 6 miles.

FIG. 8.

An earthquake shook Unalashka, and was accompanied by fearful noises. Stones, or pumice, were thrown from the new volcano as far as Umnak. With sunrise the noises ceased, the fire diminished, and the upraised island was seen as a sharp black crag. It was named after St. John the theologian, though it does not appear for what reason. It did not rise, according to the above account, on his day. A month later it was appreciably higher, and emitted flames constantly. It continued to rise, but steam and smoke took the place of fire. In 1800 the smoking appeared to cease, and in 1804 a party of hunters visited the island. They found the sea warm about it, and the surface, in some places at least, too hot to walk upon, even if the distorted fragments of lava, which formed its base, were accessible to a landing. It was said to be two miles and a half in circumference, and three hundred and fifty feet high.

[1] In 'Alaska and its resources,' by an accident in the historical chapter, the item relating to the rising of this volcano from the sea was misplaced ten years, and appears under 1806, though properly dated in the geological chapter. An agent of the census by the name of Petroff, believing apparently that a little imagination would enliven his statistics, and misled by this erroneous date, gives in his report an account of an eye-witness of the phenomenon, 'born in 1797,' and 'who was one of the individuals who first noted' it, and with such terror 'that his trembling knees could scarce carry him back to report!' (H. R. ex. doc. No. 40, p. 19, 1881.)

In 1806 fissures appeared, lined with crystals of sulphur. According to Langsdorff, who saw it in this year,[1] it did not exhibit any special activity, though steam and smoke arose more or less constantly. In this year three baidars visited the island. On the north side soft lava flowed into the sea, and it was too hot to approach closely; but on the southern end a landing was effected. The peak was too sharp and rugged to be ascended, and the rock was very hot. A piece of seal meat suspended in a crevice was thoroughly cooked in a short time. There was no soil nor fresh water.

The only map or survey of Bogosloff and vicinity known by us to exist is that of Krusenstern, published in 1826, a facsimile of which is here given, except that the evidently formal hachuring has been omitted. Since 1823, and up to the present year, the island has remained tranquil, and its form has not changed. The close similarity to our own, of Lütké's profile taken in 1827, confirms this view. The widely differing estimates of its height and area given by Grewingk illustrate the futility of unchecked guessing rather than any change in the island itself; and even the map, which could have had no base-line except one measured by log on the water, though relatively correct, represents, according to our observations, a scale about one-quarter too large, the island being about a mile and a quarter long, instead of a mile and three quarters, as the map gives it.

We have not space here to discuss the detailed process by which our conclusions have been reached, but will briefly state them.

The site of Bogosloff was a low islet or cluster of rocks not identical with the present Ship Rock, and which were long known to the Aleuts, and mapped by Levasheff. In 1795–96 a series of progressive disturbances occurred by which, in May, 1796, a considerable mass of material was upheaved and the major part of the present island formed. The reports of exactly what occurred, as well as the dates assigned, are discrepant and all unsatisfactory, when we recollect the distance from which the alleged observations were made, and that they were not noted down until several years after-

ward. The reef shown on most charts extended only a short distance from Umnak or Bogosloff, and was never continuous between them.

Other islands of exactly similar origin are to be found in this region, notably Koniúgi and Kasátochi in the western Aleutians, and Pinnacle Island near St. Mathew Island. Of the last, sketches are reproduced here, showing it ‘end on’ and from the side. It differs from Bogosloff in having the crest deeply channelled; and it has been reported, that within a few years light has been seen in this fissure by navigators passing at night, though there is no record of smoke or lava being ejected.

Of the latest addition to the list of Aleutian volcano-islands, we are not in a position to say much. The facts reported seem in brief to be these: —

During the past season, Bogosloff has been in a state of eruption, as was observed by Capt. Hague, of the steamer Dora, on two occasions, when passing it at a distance of a mile and a half. He describes it as entirely enveloped in smoke and flame, with red-hot lava issuing from its central portion, and great quantities of softer lava ru ning down to the sea. This has continued up to the time of the latest reports. The natives state that the eruption began about six months ago, and has continued in an intermittent manner ever since. Makushin volcano, on Unalashka Island, remained quiet. On the 16th of October a dark cloud of indescribable appearance covered the sky northward from Unalashka, and hung very near the earth for some time, completely excluding the light of the sun, and accompanied by a rise of temperature in the air. In about half an hour this cloud collapsed, and covered the earth with dull gray, cottony ashes of extreme lightness. This was ascribed to the Bogosloff eruption which had been heard of, though not visible from Iliuliuk harbor, where these observations were made. Another account says the fall of ashes occurred Oct. 24, and that the amount has been exaggerated.

Subsequently Capt Hague passed again in the vicinity of Bogosloff, and, to his astonishment, observed a new island which had appeared above the sea since his previous visit, and in a spot which he had previously sailed over. In the month of September Capt. Anderson, of the schooner Mathew Turner, had observed the new island, which was then a mass of fire and smoke, apparently not having taken shape. Capt. Hague reports the new peak to be situated half a mile north-north-westward from Bogosloff, to be cone-shaped, with an irregular outline, rising five to eight hundred feet above the sea, and about three-quarters of a mile in diameter.

It is stated that no further information was obtained; and none is likely to be obtainable until next spring, as communication with Unalashka is not kept up during the winter months. To examine it, a special expedition from Unalashka would be necessary; as it cannot be much less than forty-five miles from Iliuliuk harbor, in the open sea, and would be little more than visible from the nearest land. I would suggest for it the name of Grewingk Island, in honor of the celebrated geologist who monographed in 1850 all that was known of Alaskan geology and mineralogy.[1]

Since the above news was received, further intelligence has come to hand in regard to volcanic activity in Alaska, from an unexpected locality. From the entrance of Port Graham, sometimes called English Bay, at the mouth of Cook's Inlet on its eastern shore, may be seen the rounded summit of Augustin or Chernobour Island. It presented in 1880 the appearance of a low rounded dome without a peak, and measured about thirty-eight hundred feet in height by angles from different stations. The island of which it is the summit is about fifty miles from Port Graham in a south-west by west direction, is rounded and about eight miles in diameter, bluff to the north-west, and sloping to the south-east. There are many rocks about it, and it has been a noted haunt of sea-otters. It was known to be volcanic, but no description of it as active is on record so far as I can discover. According to information received from Capts. Cullie and Sands, and summarized for the press by Prof. George Davidson at San Francisco, the following observations were made at the Alexander Village at Port Graham. Smoke first arose from the peak in August. On the morning of Oct. 6 the inhabitants heard a heavy report, and saw smoke and flames issuing from the summit of the island. The sky became obscured, and a few hours later there was a shower of pumice-dust. About half-past eight o'clock the same day an earthquake wave, estimated at thirty feet in height, rolled in upon the shore, deluging the houses on the lowland, and washing the boats and canoes from the beach. It was followed by others of less height. The ash fell to a depth of several inches, and the darkness required lamps to be lighted. At night flames were seen issuing

[1] Capt. Hague proposed to name it New Bogosloff; but the derivation of the word ‘Bogosloff’ is such that a different name would be preferable.

from the summit, and the snow had disappeared from the island. After the first disturbances were over, it was found that the northern slope of the summit had fallen to the level of the cliffs which form the shore, and the mountain appeared as if split in two. Two previously quiet volcanoes on the peninsula of Aliaska began simultaneously to emit smoke and dust; and in the ten-fathom passage between Augutin Island and the mainland a new island, seventy-five feet high and a mile and a half in extent, has made its appearance. It is stated that subterranean noises had previously been heard by a party of hunters, some of whom are reported missing.

The volcano has not been approached nearer than ten miles since the eruption, at which distance the new island was distinctly seen north-west from Augustin Island. Its dimensions, therefore, are merely approximate. The morning of the eruption was perfectly clear, with a light south-west wind, and the tide extremely low. Three days before, all the fish are said to have disappeared from Port Graham. At last accounts smoke was arising from a point on Augustin Island, south from the cleft above mentioned, which crosses the island from east to west.

It would seem as if these events were local manifestations of an awakening of volcanic energy nearly world-wide. WM. H. DALL.

WHIRLWINDS, CYCLONES, AND TORNADOES.[1]—IX.

TORNADOES differ from the storms thus far mentioned in their excessive violence over a very restricted area, and their visibly rapid advance. After a great deal of theorizing, it is now possible to explain them very satisfactorily and simply as whirls in the air, a little above the ground, into the vortex of which the surface-winds are drawn up with great velocity. Electricity has no essential share in their action.

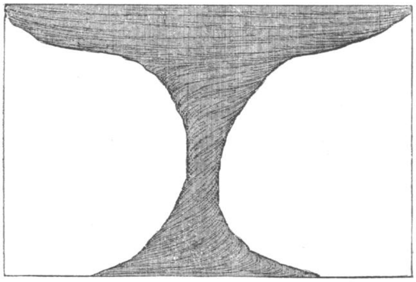
Recent studies, especially the reports by Mr. Finley of the signal-service, have done much to show us the regions of, and general conditions preceding, tornadoes. They are most numerous in Kansas, Missouri, and Illinois, although they have been recorded throughout the states east of the Mississippi, except in the far north-east and on the central Alleghanies. So they have occurred in all the months, and at nearly all hours of the day; but their time of greatest frequency is in the afternoons of June and the months adjoining. Where most fully studied, they seem to occur along the contact-line of warm southerly winds and cooler north-westerly or westerly winds. Local quiet and rather excessive warmth commonly precede them, and chilly winds come after their passage. Rain and hail fall in their neighborhood, but usually at a moderate distance away from the destructive wind-centre. Their advance is nearly always to the north-east, at about thirty miles an hour.

When first perceived, the tornado is generally described as a dark, funnel-shaped mass, hanging from heavy, dark, agitated clouds (fig. 23). Its roaring sound is heard as it comes nearer; and the whirling funnel is often seen to swing from side to side, and to rise and fall. Within its dark column, various objects snatched from the ground may be seen rising and turning round and round in the eddying winds: pine-trees appear like bushes, and barn-doors are mistaken for shingles. At a certain height these fragments are thrown laterally out of the power of the ascending current, and then fall to the ground, often with violence, from their lofty flight. If such a cloud appear in the west or south-west, one should make all possible haste to the north or south of its probable track; but there is seldom time to escape. The rapidity of the storm's approach, the noise of its roaring, the fear that its darkness and destruction naturally inspire, too often serve to take away one's presence of mind; and, before there is time for reflection, the whirl has come and passed, and the danger is over for those who survive. The force of the wind is terrific. Heavy carts have been carried, free from the ground, at such a velocity, that, when they strike, the tires are bent and twisted, and the spokes are broken from the hubs. Iron chains are blown through the air. Large beams are thrown with such strength that they penetrate the firm earth a foot or more. Children, and even men, have often been carried many feet above the ground, and sometimes dropped unhurt. A velocity of wind exceeding one hundred miles an hour is required to produce such effects. Strange examples of the wind's strength are found in the treatment of small objects: nails are found driven head first firmly into planks; a cornstalk is shot partly through a door, recalling the firing of a candle through a board. More than this, the wind shows signs of very unequal motions in a small space: bedding and clothing are torn to rags; harness is stripped from horses. Nothing can withstand the awful violence of the tornado's centre; and yet, at a little distance one side or the other, there is not only no harm

[1] Concluded from No. 50.

done, but there is no noticeable disturbance in the gentle winds. The track of marked disturbance averages only half a mile, and the path of great destruction is often only a few hundred feet wide.

The whirling at the centre is evident enough, in many cases, from the rotary motion of the funnel-cloud: it is, in all reported cases, from right to left, like the cyclones of this hemisphere. At a little distance from the centre, the wind is probably nearly radial, as is shown fully enough by the direction in which fences or trees are blown over, or houses and other loose objects carried. On the right side of the track the winds are more violent, and their destructive effect consequently reaches farther from the whirl than on the left. This is evidently because, on the right, the motion of the wind and the advance of the storm are combined, as has been explained under cyclones. Here are several examples from the Kansas tornadoes of May, 1879, as described in Finley's report, showing the opposed currents of air.



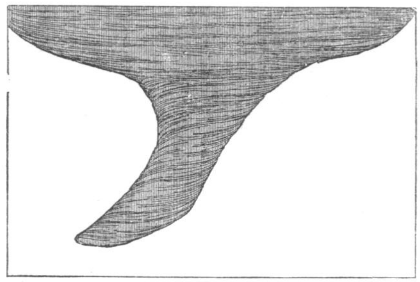


Fig. 23.[1]

Fig. 24 shows the fence on the right blown to the east; the fences on the left, to the west and south; and the hay from a stack, scattered in a curved line. When fences are not blown over, rubbish often collects on their windward side.

Fig. 25 illustrates, by arrows, the direction of the wind, by which several buildings were more or less injured; but most peculiar is the track of a man, who, on coming out of the east side of a barn, was caught up by the winds and carried half way around the building, and there set down very dizzy, but unhurt. At the same time, two horses near by were killed, their harness stripped off and torn to pieces. A scantling four inches square and ten feet long was found driven three feet and a half into the ground, only forty-five feet from its starting-point. A large board sixteen feet long was found two miles to the north-east, where it was identified by the color of its paint.

Fig. 26 shows a more disastrous case. The house was swept away, and its fragments filled the creek to the south-east. The trees west of the house were not hurt; but those in the grove on the track were blown over to the north-east, their bark and leaves stripped off, and their south-western side blackened as if burnt. In such position, branches have been found twisted from right to left about the trunks. As the storm came on, the family occupying the house ran out, turning to the north and west. One by one they were blown away, — first a little girl, who was found dead; then a girl and boy, not seriously hurt; next the mother was thrown against a tree and killed; and last, the father, carrying the baby, and becoming confused in the rushing wind, turned back from his safe flight to the west, was caught up and thrown over one hundred yards to the north-east, and killed. The accounts of tornadoes only too often give a record like this. In six hundred and odd tornadoes, forty are recorded as fatal to the people on their track. In these forty, four hundred and sixty-six lives were lost, and six hundred and eighty-seven persons were injured.

In addition to the violence of the whirling winds, an explosive effect is often noted in buildings where the windows and doors are closed. Doubtless this is one reason why roofs are so generally carried away. Doors

[1] Figs. 23, 24, 25, and 26 are from Finley's Report on tornadoes of May 29 and 30, 1879.

and windows have been blown outward. The four walls of a house have fallen outward from the centre. Still more definite is the account of a railroad-agent who had barred the window-shutters and locked the door of his station after a train had gone by. A tornado passed over it, and burst the window open outwards. Evidently the air of ordinary density within the building suddenly expands as the outside pressure of the atmosphere is taken off when the storm-centre passes. Possibly this action may aid in the plucking of poultry in tornadoes: the unfortunate chickens that are caught near the centre are nearly always stripped of their feathers. So with the remarkable penetration of mud into clothing, which cannot be cleansed by repeated washings: perhaps the air is drawn out as the storm passes, and then the mud is forced closely into the fabric by the returning atmospheric pressure. The ground

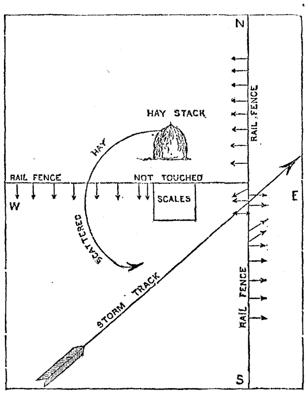


FIG. 24.

is sometimes said to look as if heavily washed on the central path: it may be that the expansion of air in a loose soil aids such a result.

Nothing can be better proven than the existence of a continuous and violent updraught at the centre of the whirl. An observer far enough from the track of the tornado to watch it composedly, and yet near enough to see it with some distinctness, seldom fails to note the rapid rising of *débris* and rubbish in the vortex, whirling as it rises; and a current of air strong enough to lift boards and beams must ascend with great energy. Most of the fragments thus captured by the wind are thrown to one side, and allowed to fall after a short flight; but smaller, lighter objects, such as hats, clothes, papers, shingles, are often carried several miles through the clouds, and dropped far away from home. But observers often report, also, that the extremity of the funnel-clouds is seen to descend, and from hanging aloft it suddenly darts downward to the ground. How can these two contradictory motions be reconciled? Simply enough: for the last is purely an apparent motion. It is simply the downward extension of the cloud-forming space faster than the cloud-particles

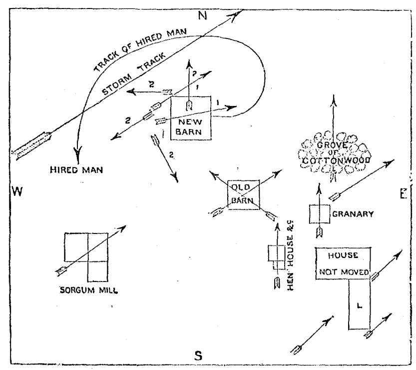


FIG. 25.

are carried upward. The same style of apparent motion against the wind may be seen in some thunder-showers where a cloud forms faster than the wind blows, and so eats its way to windward. There has been much needless mystification here, for the point was neatly explained by Franklin a century and a quarter ago. He wrote, that "the spout appears to drop or descend from the cloud, though the materials of which it is composed are all the while ascending;" for the moisture is con-

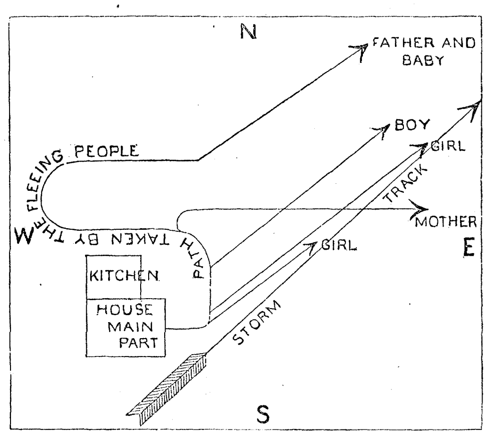


FIG. 26.

densed "faster in a right line downwards than the vapors themselves can climb in a spiral line upwards" (Franklin's Works, Sparks's ed., vi. 153, 154; letter dated Feb. 4, 1753).

Now let us look for the explanation of these varied effects, and discover, if possible, the reason of the extremely local development of such intense motions.

The explanation given for sand-whirls in the desert fails to provide for the excessive force of the tornado. A thin, warm surface-stratum of air would be prevented by friction with the ground from attaining any very excessive velocity; and, moreover, it is often excessively hot without tornadoes following, and tornadoes often happen when the air is not perfectly still. Yet, as they occur most frequently on warm or hot afternoons, surface-warmth very probably re-enforces other causes up to the point of violent storm development.

The existence of conflicting winds, as already noted, gives us more aid. So long as the cold wind passes under the warm, there will be no great disturbance, for the equilibrium will remain stable; but, if the warm wind advances under the cold, an unstable equilibrium may result. We have already seen that warm saturated air requires the smallest vertical difference of temperature to destroy its stability; and also that the saturated condition may often be met in the cloud stratum, although absent below it. For these two reasons we may infer that a tendency to upset will be more frequently reached a few hundred or thousand feet above the earth than closer to the ground. Suppose that such a condition is reached when a mass of warm southerly wind has pushed itself below the colder north-westerly stratum: the surface-air will often rest quiet and become warm below such a meeting, for the same reason that calms occur along the equator at the meeting of the trades; and a change must soon relieve this unnatural arrangement. The warm wind, feeling about for a point of escape through its cold cover, soon makes or finds a vent where it can drain away upwards; and then the entire warm mass, even a mile or more in diameter, and often more than one thousand feet in thickness, begins the rotary motion already described in whirls and cyclones, rises at the centre, and passes away. Before describing the peculiar tornado features, let us contrast the storm as now developed with the two other kinds of storms already explained. The desert-whirl arises from a thin layer of hot dry air, warmed at the place where the whirl begins, ascending in a small column through a considerable thickness of colder air. Friction with the ground prevents the attainment of an excessive velocity; and the ascending current can lift only sand and light objects. As soon as the bottom-air is drained away, the whirl stops. The cyclone is fairly compared, on account of its great horizontal extension, to a broad, relatively thin disk, with a horizontal measure several hundred times greater than its thickness, having a spiral motion of much rapidity, inward below and outward above, but a central ascending component of its motion so gentle that raindrops can ordinarily fall down through it. Its continuance depends largely on heat derived from vapor condensation: it is therefore self-acting after it has once begun, and goes on drawing in new air long after the original supply is exhausted. The tornado is like a cylinder, with a height equal to or greater than its diameter. Its warmth is chiefly imported to the point where its action begins, partly as sensible, partly as 'latent' heat; but, unlike the cyclone, its action ceases as soon as the original mass of warm air escapes upward through its warm cover. On apprehending these peculiarities, we may better appreciate its farther development.

The tornado has two motions to be considered, in addition to its general progression, — the spiral rotation, and the central updraught. The latter cannot, except under special conditions yet to be mentioned, become very rapid, for it depends primarily, simply on differences of temperature insufficient to produce very active motion; but the former attains a great velocity near the centre in virtue of the mechanical principle already quoted, — the 'preservation of areas.' When a whirling body is drawn toward the centre about which it swings, its velocity of rotation will increase as much as its radius of rotation decreases; the centrifugal force will also increase, and with the square of the velocity, or inversely as the square of the radius. This law claims obedience from air, as well as from solid bodies: hence, if the air of a tornado mass have a gentle rotary velocity of twenty or thirty feet a second at a thousand yards from the centre, this velocity will increase as the central air is drained away and the outer particles move inward; so that, when their radius is only one hundred yards, they will fly around at the rate of two or three hundred feet a second, or over one hundred and fifty miles an hour. It must be understood, however, that this requires that there should have been no loss of motion by friction, and hence can be true only for the air at a distance above the ground; and, further, that, in spite of the great horizontal rotary motion, there is still only a moderate vertical current. And consequently we have not yet arrived at the cause of the violent central and upward

winds that distinguish the tornado from other storms, but this cause is close at hand.

Admit for a moment that there is no friction between the air and the ground. We should then have a tall vertical cylinder of air, spinning around near the centre at a terrific speed, at the base as well as aloft, and consequently developing a great centrifugal force. As a result, the density of the central core of air must be greatly diminished. Most of the central air must be drawn out by friction into the whirling cylinder, and prevented from returning by the centrifugal force. The core will be left with a feeling of emptiness, like an imperfect vacuum. If there were any air near by not controlled by the centrifugal force, it would rush violently into the central core to fill it again. Now consider the effect of friction with the ground. The lowermost air is prevented from attaining the great rotary velocity of the upper parts, and consequently is much less under the control of the centrifugal force, which is measured by the square of the velocity. The surface-air is therefore just what is wanted to fill the incipient vacuum: so it rushes into the core and up through it with a velocity comparable to that of the whirling itself; and *this inward-rushing air is the destructive surface-blast of the tornado.*

This explanation, first proposed by Mr. Ferrel a few years ago, is most ingenious and satisfactory. Moreover, he has followed its several parts by close mathematical analysis, and shown that the moderate antecedent conditions are amply sufficient to account for all the violence of the observed results.

There are still several points to be considered. The whirling motion has been described as corresponding in nearly all cases with that of northern cyclones; and yet it cannot be supposed that the indraught winds of a tornado are drawn from sufficient distances to show the effect of the earth's deflective force: it is more probable that the tornado is to be regarded as a small whirl within a larger one, for the warm and cold winds are probably part of a large cyclonic system in which differential and rotary motions are established; and, when such winds form a small local whirl of their own, it will rotate in the same direction as they do, from right to left. For a like reason the planets rotate on their axes in the direction in which they revolve around the sun. The constant direction of rotation in tornadoes may therefore, by itself, be taken as evidence that their cause is not in a stagnant atmosphere, like that of the desert-whirls, but is connected with the conflicting currents of a large, gentle cyclone.

The progressive motion of the tornado-centre is so constant in its direction to the north-east or east, that it cannot depend on local conditions within itself, but must rather result from its bodily transportation by the prevailing winds, with which the tornado-tracks agree very well in direction and rate. It will last till the lower warm air, which constituted the original unstable mass, is exhausted. This generally happens in about an hour, when it has traversed a distance of nearly thirty miles.

The tornado thus constituted may be likened to a very active air-pump, carried along a few hundred feet above the ground, sucking up the air over which it passes. It is for this reason that the surface-winds are so nearly radial. For this reason an enclosed mass of air, as in a house, suddenly explodes as the vacuum is formed over it; and as the air rushes to the centre, and there expands and cools, its vapor becomes visible in the great funnel, or spout, pendent from the clouds above. No rain can fall at the centre. Bodies much heavier than rain are lifted there, instead of dropped: so the rain must rise through the central core, and fall to one side of the storm, or before or behind it. If the expansion be very great, and the altitude reached by the drops rather excessive, then they will be frozen to hailstones before falling. Hail-storms and tornadoes commonly go together: they mutually explain each other. Electricity has no important part to play in the disturbance.

It was stated under cyclones that their central barometric depression had two causes, — the overflow caused by the central warmth, and the dishing-out of the air by centrifugal force. The first of these is ordinarily regarded as the effective cause of the wind's inward blowing. It has already been pointed out that the second and greater part of the depression is also effective in drawing in the winds when friction decreases their rotary velocity. We may now call attention to a third cause of centripetal motion in the cyclone already alluded to, in which it is like the tornado. The upper winds move with great rapidity, and cause a strong barometric depression at the centre of their whirling; but at the base of the storm, where friction with the sea, or still more with the land, reduces the lower wind's motion, and so diminishes their centrifugal force, we may have an indraught of the tornado style, in which the centrifugal diminution of central pressure in the upper winds is an effective cause of centripetal motion in the lower winds. While this is not the principal cause of surface-

winds in a cyclone, it may be an important aid to central warmth.

Water-spouts are closely allied to tornadoes: but when seen in small form they approach the character of simple desert-whirls; that is, they then depend merely on air warmed at the place where they occur, and not on the running together of warm and cold winds from other regions. A probable cause for the excess of their strength above that of the sand-whirls lies in the smoothness of the water-surface on which they spring up, which will allow a long time of preparation; and in the moisture in the air, which will cause the warming of a greater thickness than if the air were very dry. The greater the thickness, the more their action will resemble that of a typical tornado. The appearance of the downward extension of the funnel-shaped cloud to meet the rising column of water is almost certainly only an appearance, and has the explanation already quoted from Franklin's ingenious writings.

We have relied largely, in the preceding explanations, on deductions from general principles, checked by the results of observation. The writings of many investigators have been examined, and in a few cases their names have been given; but the literature of the subject is now so extensive that full reference has been deemed unadvisable. Little attention has been paid to the older theories, in which conflicting winds and electricity were looked on as the chief causes of storms. The latter is regarded as an effect rather than a cause; and, while the former has much importance when rightly considered in connection with the earth's rotation, it is of small value as originally stated, and is then limited to the production of short-lived storms in mountainous districts. The more important factors of the modern theory of storms are the consideration of the conditions of stable and unstable equilibrium of the atmosphere, the true measure of the action of condensing water-vapor, the full estimation of the effect of the earth's rotation, and the recognition of the necessary increase in the wind's velocity as it is drawn in toward the storm-centre. W. M. DAVIS.

THE CRITICAL STATE OF GASES.

THE *Philosophical magazine* for August, 1883, contains a letter from Dr. William Ramsay which refers to observations upon the critical state of gases, published in the Proceedings of the London royal society, 1879–80. The chief observations that had previously been made upon this interesting subject are those of Cagniard de la Tour (*Annales de chimie*, 2ème série, xxi. et xxii.), Faraday (*Phil. trans.*, 1823 and 1845), Thilorier (*Annales de chimie*, 2ème série, lx.), Natterer (*Pogg. ann.*, xciv.), Andrews (*Phil. trans.*, 1869). Andrews found that when a gas was compressed in a closed space, and was maintained at a temperature below a certain limit, the pressure of the gas increased up to a fixed point, beyond which condensation occurred. The pressure at which condensation takes place increases rapidly with the temperature of the gas. At and beyond a certain temperature — the critical temperature — no amount of pressure can produce any of the usual phenomena of condensation. The isothermal lines below the critical temperature are apparently discontinuous, one portion representing no change of pressure corresponding to a change of volume. Above the critical temperature the isothermals are continuous.

The experiments of Dr. Ramsay were made upon benzine and ether, and a mixture of equal weights of benzine and ether. In one experiment a closed glass tube, somewhat in the shape of an hourglass, was used. One end of the tube was partly filled with ether, and was heated in an inclined position. The liquid expanded until, at the moment the meniscus disappeared, it nearly filled the lower half of the tube. On cooling, the liquid all condensed in the lower half.

The experiment was varied by inverting the tube after the meniscus had disappeared. On cooling, the liquid condensed in the upper half of the tube. The tube was next maintained for some time at a temperature above that at which the meniscus disappeared. On cooling, an equal quantity condensed in each division of the tube. It was observed, that, after the meniscus had disappeared, the part of the tube containing liquid had a different index of refraction from the other part.

The conclusion to be drawn from these results is, that, at and above the critical point, the density of the liquid is the same as that of its saturated vapor: consequently, after a sufficient time, the liquid and its vapor will become mixed. Above the critical point, the surface tension of a liquid disappears.

This conclusion is confirmed by the experiments of M. Cailletet (*Comptes rendus*, Feb. 2, 1880). He found that when the lower part of his experimental tube was filled with liquid carbonic anhydride at a temperature of 5°.5, and the upper part was filled with air and gaseous carbonic anhydride, a pressure of a hundred and fifty to two hundred atmospheres was necessary to cause the liquid to mix with the gas. At the suggestion of Mr. Jamin (*Comptes rendus*, May 21, 1883), hydrogen was substituted for the air in the upper part of the tube, and it was then found that a greater pressure was necessary to produce the mixture. This result would necessarily follow if we suppose that the mixture takes place when the densities of the liquid and the gas become equal. We cannot say that the liquid is converted into gas by pressure.

Though the densities of a liquid and its saturated vapor are equal, above the critical point, the two states of matter are still distinguished by other physical properties. Their indices of refraction are differ-

ent: the liquid is capable of dissolving solids which are insoluble in the vapor. The latter fact is proved by the experiments of Hannay and Hogarth (*Proc. roy. soc.*, Oct., 1879), and also by similar experiments of Dr. Ramsay. A small piece of potassium iodide was placed in the lower part of the experimental tube, which was partly filled with anhydrous alcohol. The upper part of the tube was free from alcohol, but its sides were covered with a film of crystalline potassium iodide. When the tube was heated and the meniscus disappeared, the salt in the lower part of the tube was dissolved, while that in the upper part remained unchanged. Similar observations were made on eosine.

Dr. Ramsay's second paper contains the isothermal lines for benzine, ether, and a mixture of benzine and ether, below and above the critical temperatures. The apparatus used resembled that of Andrews. The most remarkable feature of these lines is, that, below the critical temperature for benzine, there appears to be a diminution of pressure corresponding to a diminution of volume, immediately before complete condensation takes place. This phenomenon appears very slightly in a mixture of benzine and ether, but is not apparent in ether alone. It has been suggested by James Thomson (*Proc. roy. soc.*, 1871) that the isothermals for all gases might have somewhat this form below the critical temperature. Dr. Ramsay explains the fact by supposing that the molecules, when the gas has been compressed to a certain extent, begin to exert mutual attraction and relieve the pressure. The fact may be connected with the observed phenomenon that the meniscus of benzine remains easily distinguishable until it vanishes, whereas the meniscus of ether soon becomes hazy. At the part of the isothermal under consideration the substance is evidently in a condition of unstable equilibrium, and it is difficult to see how this part of the curve could have been detected experimentally.

The critical temperature and pressure of a mixture of benzine and ether were found to be not far removed from the mean of the critical temperatures and pressures of the components.

No direct experiments have yet been made to ascertain whether heat is evolved when a gas is converted into liquid by pressure at temperatures above its critical temperature. Mr. Jamin concludes that at and beyond the critical point there is no latent heat. This conclusion, however, does not seem probable; since the molecular constitution of a liquid and its vapor are probably different, even above the critical temperature.

The conclusions which Ramsay draws from his experiments are summed up as follows: —

"1°. A gas may be defined as a body whose molecules are composed of a small number of atoms.

"2°. A liquid may be regarded as formed of aggregates of gaseous molecules, forming a more complex molecule.

"3°. Above the critical point, the matter may consist wholly of gas if a sufficient volume be allowed, wholly of liquid if the volume be sufficiently diminished, or of a mixture of both at intermediate volumes. That mixture is, physically speaking, homogeneous in the same sense as a mixture of oxygen and hydrogen gases may be termed homogeneous."

C. B. PENROSE.

COLORED SKIES AFTER AN ERUPTION OF COTOPAXI.[1]

THE remarkable sunsets which have been recently witnessed upon several occasions have brought to my recollection the still more remarkable effects which I witnessed in 1880 in South America, during an eruption of Cotopaxi; and a perusal of your highly interesting letter in the *Times* of the 8th inst. has caused me to turn to my notes, with the result of finding that in several points they appear to have some bearing upon the matter which you have brought before the public.

On July 3, 1880, I was engaged in an ascent of Chimborazo, and was encamped on its western side at 15,800 feet above the sea. The morning was fine, and all the surrounding country was free from mist. Before sunrise we saw to our north the great peak of Illiniza, and twenty miles to its east, the greater cone of Cotopaxi; both without a cloud around them, and the latter without any smoke issuing from its crater, — a most unusual circumstance: indeed, this was the only occasion on which we noticed the crater free from smoke during the whole of our stay in Ecuador. Cotopaxi, it should be said, lies about forty-five miles south of the equator, and was distant from us sixty-five miles.

We had left our camp, and had proceeded several hundred feet upwards, being then more than 16,000 feet above the sea, when we observed the commencement of an eruption of Cotopaxi. At 5.45 A.M. a column of smoke of inky blackness began to rise from the crater. It went up straight in the air, rapidly curling, with prodigious velocity, and in less than a minute had risen 20,000 feet above the rim of the crater. I had ascended Cotopaxi some months earlier, and had found that its height was 19,600 feet. We knew that we saw from our station the upper 10,000 feet of the volcano, and I estimated the height of the column of smoke at double the height of the portion seen of the mountain. The top of the column was therefore nearly 40,000 feet above the sea. At that elevation it encountered a powerful wind blowing from the east, and was rapidly borne for twenty miles towards the Pacific, seeming to spread very slightly, and remaining of inky blackness, presenting the appearance of a gigantic inverted ⌊ drawn upon an otherwise perfectly clear sky. It was then caught by a wind blowing from the north, and was borne towards us, and appeared to spread rapidly in all directions. As this cloud came nearer and nearer, so, of course, it seemed to rise higher and higher in the sky, although it was actually descending. Several hours passed before the ash commenced to intervene between the sun and ourselves; and, when it did so, we witnessed effects which simply amazed us. We saw a green sun, and

[1] From *Nature*, Dec. 27. A letter sent to Mr. Norman Lockyer.

such a green as we have never, either before or since, seen in the heavens. We saw patches or smears of something like verdigris-green in the sky; and they changed to equally extreme blood-reds, or to coarse brick-dust reds, and they in an instant passed to the color of tarnished copper or shining brass. Had we not known that these effects were due to the passage of the ash, we might well have been filled with dread instead of amazement; for no words can convey the faintest idea of the impressive appearance of these strange colors in the sky, seen one minute and gone the next, resembling nothing to which they can be properly compared, and surpassing in vivid intensity the wildest effects of the most gorgeous sunsets.

The ash commenced to pass overhead at about midday. It had travelled (including its détour to the west) eighty-five miles in a little more than six hours. At 1.30 it commenced to fall on the summit of Chimborazo, and, before we began to descend, it caused the snowy summit to look like a ploughed field. The ash was extraordinarily fine, as you will perceive by the sample I send you. It filled our eyes and nostrils, rendered eating and drinking impossible, and reduced us to breathing through handkerchiefs. It penetrated everywhere, got into the working-parts of instruments and into locked boxes. The barometer employed on the summit was coated with it, and so remains until this day. That which ssed beyond us must have been finer still. It travelled far to our south, and also fell heavily upon ships on the Pacific. I find that the finer particles do not weigh the twenty-five thousandth part of a grain, and the finest atoms are lighter still. By the time we returned to our encampment, the grosser particles had fallen below our level, and were settling down into the valley of the Chimbo, the bottom of which was 7,000 feet beneath us, causing it to appear as if filled with thick smoke. The finer ones were still floating in the air, like a light fog, and so continued until night closed in.

In conclusion, I would say that the terms which I have employed to designate the colors which were seen are both inadequate and inexact. The most striking features of the colors which were displayed were their extraordinary strength, their extreme coarseness, and their dissimilarity from any tints or tones ever seen in the sky, even during sunrises and sunsets of exceptional brilliancy. They were unlike colors for which there are recognized terms. They commenced to be seen when the ash began to pass between the sun and ourselves, and were not seen previously. The changes from one hue to another, to which I have alluded, had obvious connection with the varying densities of the clouds of ash that passed; which, when they approached us, spread irregularly, and were sometimes thick and sometimes light. No colors were seen after the clouds of ash passed overhead and surrounded us on all sides.

I photographed my party on the summit of Chimborazo whilst the ash was commencing to fall, blackening the snow-furrows; and, although the negative is as bad as might be expected, it forms an interesting souvenir of a remarkable occasion.

EDWARD WHYMPER.

MODERN PHYSIOLOGICAL LABORATORIES: WHAT THEY ARE AND WHY THEY ARE.[1] — II.

WE have seen that Haller laid the foundation of the knowledge that the body of one of the higher animals was essentially an aggregation of many organs, each having a sort of life of its own, and in health co-operating harmoniously with others for the common good. In the early part of this century, before scientific thought had freed itself from mediaeval guidance, this doctrine sometimes took fantastic forms. For example: a school arose which taught that each organ represented some one of the lower animals. DuBois-Reymond relates that in 1838 he took down these notes at the lectures of the professor of anthropology: —

> "Each organ of the human body answers to a definite animal, is an animal. For example, the freely movable, moist, and slippery tongue is a cuttlefish. The bone of the tongue is attached to no other bone in the skeleton; but the cuttlefish has only one bone, and consequently this bone is attached to no other. It follows that the tongue is a cuttlefish."

However, while Professor Steffens and his fellow-transcendentalists were theorizing about organs, others were at work studying their structure; and a great step forward was made in the first year of our century by the publication of Bichat's 'Anatomie générale.' Bichat showed that the organs of the body were not the ultimate living units, but were made up of a number of different interwoven textures, or *tissues*, each having vital properties of its own. This discovery paved the way for Schwann and Schleiden, who laid the foundation of the cell-theory, and showed, that, in fundamental structure, animals and plants are alike, the tissues of each being essentially made up of aggregates of more or less modified microscopic living units called cells. Our own generation has seen the completion of this doctrine by the demonstration that the essential constituent of the cell is a peculiar form of matter named protoplasm, and that all the essential phenomena of life can be manifested by microscopic lumps of this material; that they can move, feed, assimilate, grow, and multiply; and still further, that, wherever we find any characteristic vital activity, we find some variety of protoplasm. Physiology thus became reduced, in its most general terms, to a study of the faculties of protoplasm; and morphology, to a study of the forms which units or aggregates of units of protoplasm, or their products, might assume. The isolation of botany, zoölogy, and physiology, which was threatened through the increased division of labor, brought about by increase of knowledge, necessitating a limitation of special study to some one field of biology, was averted; and the reason was given for that principle which we have always insisted upon here, — that beginners shall be taught the broad general laws of living matter before they are permitted to engage in the special study of one department of biology.

If I be asked, what have biological science in general, and physiology in particular, done for mankind

[1] Concluded from No. 50. Address by Dr. H. Newell Martin.

to justify the time and money spent on them during the past fifty years, I confess I think it a perfectly fair question; and fortunately it is one very easy to answer. Leaving aside the fruitful, practical applications of biological knowledge to agriculture and sanitation, I will confine myself to immediate applications of the biological sciences to the advance of the theory, and, as a consequence, of the art, of medicine.

So long as the life of a man was believed to be an external something apart from his body, residing in it for a while, diseases were naturally regarded as similar extrinsic essences or entities, which invade the body from without, and fought the 'vital force.' The business of the physician was to drive out the invader without expelling the vital spirits along with it, — an unfortunate result, which only too often happened. To the physicians of the sixteenth century a fever was some mysterious, extraneous thing, to be bled, or sweated, or starved out of the body, much as the medicine men of savages try to scare it off by beating tomtoms around the patient. Once life was recognized as the sum total of the properties of the organs composing the body, such a theory of disease became untenable, and the basis of modern pathology was laid. Disease was no longer a spiritual, indivisible essence, but the result of change in the structure of some one or more of the material constituents of the body, leading to abnormal activity. The object of the physician became, not to expel an imaginary, immaterial enemy, but to restore the altered constituent to its normal condition.

The next great debt which medicine owes to biology is the establishment of the cell-doctrine, — of the fact that the body of each one of us is made up of millions of little living units, each with its own properties, and each in health doing its own business in a certain way, under certain conditions, and no one cell more the seat of life than any other. The activities of certain cells may, indeed, be more fundamentally important to the maintenance of the general life of the whole aggregate than that of others; but these cells, which, by position or function, are more essential than the rest, were, in final analysis, no more alive than they. Before the acceptance of the cell-doctrine, pathologists were practically divided into two camps, — those who believed that all disease was primarily due to changes in the nervous system, and those who ascribed it to alteration of the blood. But with the publication of Virchow's 'Cellular pathology' all this was changed. Physicians recognized that the blood and nerves might at the outset be all right, and yet disease originate from abnormal growth or action of the cells of various organs. This new pathology, like the older, was for a time carried to excess. We now know that there may be general diseases primarily due to changes in the nervous system, which binds into a solidarity the organs of the body, or of the blood, which nourishes all; but we have also gained the knowledge that very many, if not the majority, of diseases have a local origin, due to local causes, which must be discovered if the disease is to be successfully combated. An engineer, if he find his machinery running imperfectly, may endeavor to overcome this by building a bigger fire in his furnace, and loading the safety-valve. In other words, he may attribute the defect to general causes; and in so far he would resemble the old pathologists. But the skilled engineer would do something different. If he found his machinery going badly, he would not jump forthwith to the conclusion that it was the fault of the furnace, but would examine every bearing and pivot in his machinery, and, only when he found these all in good working-order, begin to think the defect lay in the furnace or boiler; and in that he would resemble the modern physician instructed in the cell-doctrine.

A third contribution of biology to medical science is the germ-theory as to the causation of a certain group of diseases. To it we owe already antiseptic surgery; and we are all now holding our breath in the fervent expectation that in the near future, by its light, we may be able to fight scarlet-fever, diphtheria, and phthisis, not in the bodies of those we love, but in the breeding-places, in dirt and darkness, of certain microscopic plants.

From one point of view the germ-theory may seem a return to the idea that diseases are external entities which attack the body; but note the difference between this form of the doctrine and the ancient. We are no longer dealing with immaterial, intangible hypothetic *somethings*; and the modern practitioner says, "Well, show me the bacteria, and then prove that they can cause the disease: until you can do that, do not bother me about them."

It is worth while, in passing, to note that these three great advances in medical thought were brought about by researches made without any reference to medicine. Haller's purely physiological research into the properties of muscles laid the foundation of a rational conception of disease. The researches of Schwann on the microscopic structure of plants, and since then of others on the structure of the lowest animals, led to the cellular pathology. Antiseptic surgery is based on researches carried out for the sole purpose of investigating the question as to spontaneous generation. My friend Dr. Billings has described "the languid scientific swell, who thinks it bad style to be practical, and who makes it a point to refrain from any investigations which lead to useful results, lest he might be confounded with mere practical men." Well, I am sorry for the swell; because, for the life of me, I cannot see how he can make any investigations at all. The members of his class must anyhow be so few in number that we need not much grieve over them. Personally I never have met with an investigator who would not be rejoiced to find any truth discovered by him put to practical use; and I feel sure that in this day and generation the danger is rather that disproportionate attention will be devoted to practical applications of discoveries already made, to the exclusion of the search for new truth. So far as physiology is concerned, it has done far more for practical medicine, since it began its own independent career, than when it was a mere branch of the medical curriculum. All the history of the physical sciences shows that each of them has con-

tributed to the happiness and welfare of mankind in proportion as it has been pursued by its own methods, for its own ends, by its own disciples. As regards physiology, this is strikingly illustrated by a comparison of the value to medicine of the graduation theses of Parisian and German medical students. As probably you all know, a candidate for the doctorate of medicine in those countries, as in many schools here, must present a graduation thesis on some subject connected with his studies. Every year a certain number select a physiological topic. The French student usually picks out some problem which appears to have a direct bearing on the diagnosis or treatment of disease, while the German very often takes up some physiological matter which on the surface has nothing to do with medicine. Now, any one who will carefully compare for a series of years the graduation theses in physiology, of German and French candidates, will discover that even the special practical art of medicine itself is to-day far more indebted to the purely scientific researches of the German students than to those of the French, undertaken with a specific practical end in view. Situated as we shall be here, in close relation to a medical school, and yet not a part of it, I believe we shall be under the best possible conditions for work. Not under too direct pressure of the influence of the professional staff and students, on the one hand, on the other we shall be kept informed and on the alert as to problems in medicine capable of solution by physiological methods.

I must find time to say a few words as to the connection of physiology with pathology and therapeutics. The business of the physiologist being to gain a thorough knowledge of the properties and functions of every tissue and organ of the body, he has always had for his own purposes to place these tissues under abnormal conditions. To know what a muscle or a gland is, he has to study it not merely in its normal condition, but when heated or cooled, supplied with oxygen or deprived of it, inflamed or starved, and see how it behaves under the influence of curari, atropine, and other drugs. From the very start of physiological laboratories, a good deal of the work done in them has necessarily been really experimental pathology and experimental therapeutics. I suppose to-day that at least half of the work published from physiological laboratories might be classed under one or other of these heads. And what has been the fruit? I can here refer only to one or two examples. It is not too much to say, that, though inflammation is the commonest and earliest recognized of pathological states, we really knew nothing about it until the experimental researches of Lister, Virchow, and Cohnheim; and that all we really know as to the nature of fever is built on the similar researches of Bernard, Haidenhain, Wood, and others. As to therapeutics, so far as giving doses of medicine is concerned, it, still in its very infancy, had its birth as an exact science in physiological laboratories. Every modern text-book on the subject gives an account of the physiological action of each drug. What the future may have in store for us by pursuit of these inquiries it is hard to limit. The work of Bernard, — showing that in curari we had a drug that would pick out of the whole body, and act upon, one special set of tissues, the endings of the nerve-fibres in muscle, — and the results of subsequent exact experiments as to the precise action of many drugs upon individual organs or tissues, hold out before us a hope that perhaps at no very distant day the physician will know exactly, and in detail, what every drug he puts into his patient is going to do in him.

Pathology and therapeutics, while almost essential branches of physiological inquiry, have nevertheless their own special aims; and, now that the physiologists have proved that it is possible to study these subjects experimentally, special laboratories for their pursuit are being erected in Germany, France, and England. These laboratories are stocked with physiological instruments, and carry on their work by physiological methods. Those who guide them, and those who work in them, must be trained physiologists: if not, the whole business often degenerates into a mere slicing of tumors and putting up of pickled deformities: pathological anatomy is a very good and important thing in itself, but it is not *pathology*. Looking at the vast field of pathological and therapeutic research open to us, and bearing in mind the certainty of the rich harvest for mankind which will reward those who work on it, I regard as one of my chief duties here to prepare in sound physiological doctrine, and a knowledge of the methods of experiment, students who will afterwards enter laboratories of experimental pathology and pharmacology immediately connected with our medical school.

If the relations of the biological sciences to medicine be such as I have endeavored to point out, what place should they occupy in the medical curriculum? That men fitted for research, and with opportunity to pursue it, should be trained to that end, is all well and good; but how about the ninety per cent who want simply to become good practitioners of medicine? What relation is this laboratory to hold to such men, who may come to it, intending afterwards to enter a medical school? As a part of their general college-training, of that education of a gentleman which every physician should possess, it should give them specially a thorough training in the general laws which govern living matter, without troubling them with the minutiae of systematic zoölogy or botany; it should enable them to learn how to dissect, and make them well acquainted with the anatomy of, one of the higher animals; it should teach them how to use a miscroscope, and the technique of histology, and finally, by lectures, demonstration, and experiment, make known to them the broad facts of physiology, the means by which those facts have been ascertained, and the sort of basis on which they rest. The man so trained, while obtaining the mental culture which he would gain from the study of any other science, is specially equipped for the study of medicine. Trained in other parts of his general collegiate course to speak and write his own language correctly, having acquired a fair knowledge of mathematics and Latin, able to read at least French and German, having learned the

elements of physics and chemistry, and, in addition, having studied the structure and properties of the healthy body, he can, on entering the technical school, from the very first turn his attention to professional details. Knowing already the anatomy of a cat or dog, he knows a great part of human anatomy, and need do little but acquaint himself with the surgical and medical anatomy of certain regions. Knowing normal histology, he can at once turn his attention to the microscopy of diseased tissues. Well instructed in physiology, he can devote himself to its practical applications in the diagnosis and treatment of disease. The demand for an improvement in medical education, which has been so loudly heard in England and this country for some years, is (the more I think of it, the more I feel assured) to be met, not, as has been the case in England, by putting more general science into the medical-school curriculum, but by confining *that* more strictly to purely professional training, and by providing, as we have attempted to do here, non-technical college-courses for undergraduates, which, while giving them a liberal education, shall also have a distinct relation to their future work. Personally I regard it as the most important of my duties, to prepare students to enter medical schools in this city or elsewhere.

To advance our knowledge of the laws of life and health; to inquire into the phenomena and causes of disease; to train experimenters in pathology, therapeutics, and sanitary science; to fit men to undertake the study of the *art* of medicine, — these are the main objects of our laboratory. I do not know that they can be better summed up than in the words of Descartes, which I would like to see engraved over its portal: "If there is any means of getting a medical theory based on infallible demonstrations, that is what I am now inquiring."

THE CLOSING REPORT OF HAYDEN'S SURVEY.

Twelfth annual report of the U. S. geological and geographical survey of the territories: a report of progress of the exploration in Wyoming and Idaho for the year 1878. Washington, *Government printing-office*, 1883. 2 vols. 8°. With portfolio of maps and panoramas.

IN two stout octavo volumes, with an accompanying portfolio of maps, Dr. Hayden presents the twelfth and last annual report of the Geological survey of the territories. While the late reorganization and consolidation of the surveys which have been occupied in the scientific exploration of the west is indubitably a very marked step in advance, it is not without a measure of regret that we realize that Dr. Hayden's familiar and always welcome annual report now reaches us for the last time. It is perhaps only those having some experience of similar work who can fully appreciate the energy and maintained scientific enthusiasm necessary for the conduct of an organization such as that which under Dr. Hayden has built so broad a foundation for our geological knowledge of the western part of the continent.

The volumes now issued constitute the report for 1878, the concluding season of field-work. Great care has evidently been given to the editing and printing of the report; and the number and good quality of the illustrations and maps are noteworthy features. Of plates alone, in the two volumes, there are over two hundred and fifty; and most of them are excellent specimens of lithographic art.

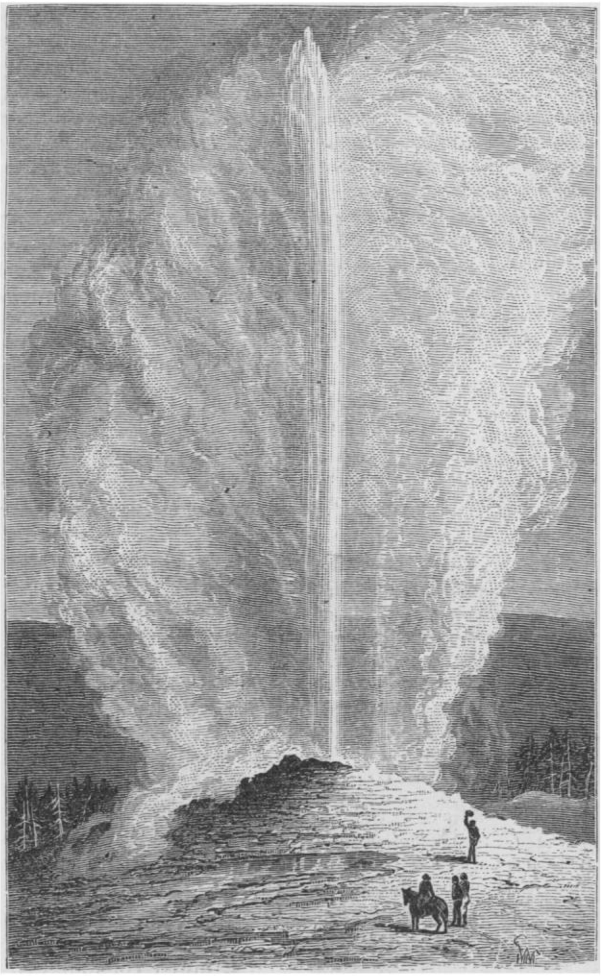
The first volume is devoted chiefly to paleontology and zoölogy, while the second may be regarded as a memoir on the Yellowstone national park. Dr. C. A. White, in his report, under the title of 'Contributions to invertebrate paleontology, No. 2,' presents the second part of his descriptions and illustrations of cretaceous fossils. This is followed (as parts 4 to 8 of the contributions) by papers on tertiary, Laramie, Jurassic, triassic, and carboniferous fossils. The article on the Laramie, including, besides the descriptions and plates of a number of forms, a systematic enumeration of the invertebrate fossils of the group, assumes the character of a synopsis of its fauna invaluable to the student of this period of geological history. Mr. Orestes St. John's very comprehensive and systematic report on the Wind River district could be done justice to only in a separate note of some length.

Mr. S. H. Scudder's report on the tertiary lake-basin of Florissant is next in order. From this place a number of fossil plants and a few fishes and birds have been obtained: but it is specially remarkable for the wonderfully numerous remains of insects which it affords; "having yielded in a single summer more than double the number of specimens which the famous localities at Oeningen, in Bavaria, furnished Heer in thirty years." The fossils occur in fine-grained volcanic ash-beds, which, together with coarser materials of the same origin, constitute the deposits of the old lake-basin. The age of the beds is apparently about that of the oligocene, and the climatic conditions may have resembled those of the northern shores of the Gulf of Mexico at the present day. A complete description of the insects will be awaited with much interest. Mr. Packard's monograph of the phyllopod Crustacea of North America, having been already noticed in *Science*,[1] need only be mentioned. In the latter part of the first volume, Dr. R. W. Shufeldt treats of the osteology of the Cathartidae

[1] Vol. ii. p. 571.

and North-American Tetraonidae, the burrowing owl, horned lark, and shrike.

On the Yellowstone national park, or reservation as it may perhaps more fitly be called, much has already been written, both of a scientific and popular character; but the second volume of the present report is the first proximately complete account of its physical and geological features. The first scientific exploration of this wonderful region was that of the survey of the territories in 1871 and 1872; and it is largely due to the personal efforts of Dr. Hayden that the district was set apart as a national park. Though reports more or less garbled, of its geysers and hot-springs, were from an early period in circulation in the west, they were not generally credited; and it is a remarkable fact, that this region, in the midst of so much active exploration of the west, continued so long practically unknown. It remained for the ubiquitous western 'prospector' to afford some intelligible account of its character between 1863 and 1869; and Dr. Hayden's first exploration followed not long thereafter.



OLD FAITHFUL GEYSER IN ACTION, 1871.

The reservation is situated mainly in north-western Wyoming, but embraces also portions of Idaho and Montana. It is about 65 by 53 miles in extent, with a computed area of 3,312 square miles, of which nearly 200 square miles are occupied by lakes. To the north and east are bounding ranges of lofty and rugged mountains; but, apart from the cañons of the rivers, the region itself does not abound in grand scenery, consisting chiefly of high rolling plateaus covered with dark coniferous forest, but, along the borders of the streams, opening out into the attractive park-like country characteristic elsewhere of many of the sub-alpine valleys of the Rocky Mountains. The mean elevation, being about eight thousand feet, renders it subject to frosts throughout the summer, and quite unfit for agriculture: indeed, the frequent reference to snow-storms as interfering with the operations of 1878 would alone be sufficient to indicate the sub-arctic character of the climate.

The geology of the park is reported on by Mr. W. H. Holmes, who carries with him throughout a clear appreciation of the bearing of observed facts on the causes and history of the remarkable events of which this portion of the 'great divide' has been the theatre. While most of the formations known in the north-west are represented in the park, a glance at the map shows that those of volcanic origin cover by far the greatest area; and it is in connection with these that its special features have been developed. Volcanic conglomerates of tertiary age are particularly prominent, and attain in some places a very great thickness. Rhyolite preponderates, but basalts also frequently occur; and the existence of large masses of obsidian or volcanic glass is a point both of mineralogical, and, from the use made of it by the Indians, ethnological interest.

From the deeply eroded valley of the Yellowstone, almost all the facts as to the pre-tertiary history of the park are drawn; and the line of this river appears to have been determined by a great fault for which a minimum estimate of the displacement is given at 15,000 feet. This fault was probably synchronous with the general Rocky Mountain uplift, and is presumed to be in more or less direct causal connection with the subsequent remarkable history of the district. It is not a simple fissure, but a break along which the edges of the strata have been much dragged and contorted, particularly on the dropped side; appearing, in fact, to have the character of a great flexure pushed to fracture. On its northern side rises the Yellowstone Range; while to the south, in the depressed area, are found the evidences of that prodigious volcanic activity of which the actual thermal phenomena are the last lingering stages.

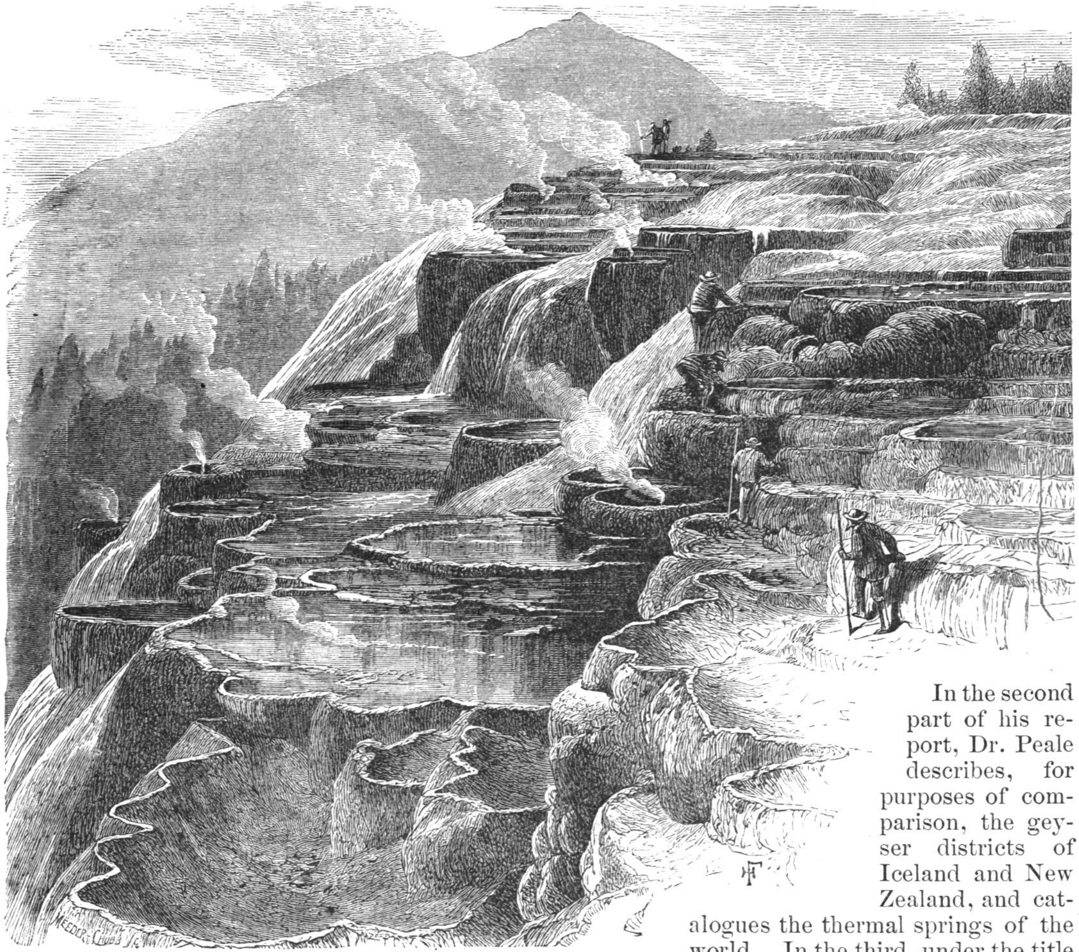
From the older tertiary rocks of the park have been collected a number of plants which Professor Lesquereux refers to the Fort Union group; but, before the inauguration of the volcanic periods, these beds, together with the paleozoic rocks, had been deeply scored by erosion. The earlier flows of trachyte and rhyolite poured into the then existing valleys till they were, in many cases at least, entirely obliterated, and the successors of these first rivers forced to cut new channels having little or no reference to the position of the old. Subsequent lava-flows again filled these later valleys, and, through the succeeding basaltic and conglomeritic epochs of activity, this process appears to have been repeated many times. The entire period of volcanic activity must have been of extremely long duration, and may have lasted through a great part of the tertiary. From the volcanic conglomerates of Amethyst Mountain, plants of upper miocene or lower pliocene age have been identified. Very much yet remains, however, to be discovered in the history of this prolonged period, which, in its succession of volcanic outbursts alternating with epochs of quiet river-work, much resembles that of the classic tertiary volcanic region of central France, and may, when fully disclosed, tell as interesting a story. In Amethyst Mountain some of the latest stages are well exemplified, and we have, perhaps, the finest series of buried erect forests ever discovered. The volcanic rocks, here characteristically conglomeritic, show a thickness of five thousand feet, and are charged almost throughout with the silicified remains of ancient forests. The lower layers are comparatively fine grained, but are followed by conglomerates which become coarser and more breccia-like in ascending, but are throughout interbedded with sandstones, and shaly layers largely tufaceous in character, and appear to be partly water-bedded and partly sub-aerial. The intervals between successive eruptions have been sufficient to allow the surface to become clothed again and again by a heavy forest-growth, each of which has been destroyed and buried in turn.

GRAND CAÑON OF THE YELLOWSTONE.

There can be little doubt that the hot-springs have been continuously in existence since the volcanic period; and actual evidence of their great antiquity is found in the occurrence of fragments of the characteristic calcareous deposit in some of the higher river-terraces, since the formation of which the Yellowstone has cut for itself a cañon a thousand feet in depth.

For an account of the hot-springs and geysers as found at the present day, we must, however, turn to the second section of the report, in which Dr. Peale treats the subject in an exhaustive manner, tabulating over two thousand springs and seventy-one

geysers. The springs show some evidence of linear arrangement, but dispose themselves for purposes of investigation in a series of groups, which are systematically described, mapped, and illustrated. The eruptions of the principal geysers are tabulated with the purpose of investigating the regularity, or otherwise, of the eruption periods ; and, in collecting and reviewing all that has already been observed on this point, Dr. Peale has had by no means a light task. So many accounts have already appeared of the more remarkable geysers and springs, that their main features have become more or less familiar to all, in so far as they can be made so by description. The Giant, Castle, Grand, Old Faithful, Giantess, Bee-Hive, and others of the best known geysers, are included in the upper geyser basin of the Fire-Hole River; and the flow of heated water is here so great as to notably affect the temperature of the stream itself. In this area alone, not quite four square miles in extent, 440 springs are known, of which 26 are veritable geysers, some, during these paroxysms of eruption, producing columns of 150 to 250 feet in height.



BASINS AT MAMMOTH HOT-SPRINGS OF GARDINER'S RIVER.

In the second part of his report, Dr. Peale describes, for purposes of comparison, the geyser districts of Iceland and New Zealand, and catalogues the thermal springs of the world. In the third, under the title of 'Therma-hydrology,' the general features of hot-springs are discussed : their physical and thermal conditions, formations and deposits, and geyseric phenomena, are reviewed, bringing out many points of interest. The geysers of all parts of the world are essentially similar in character. Those of the park are remarkable for the development of chimneys, or cones, at their orifices, — a fact attributed to the greater antiquity of the now existing vents, but which, it appears

equally probable, may arise from the greater dryness of air in the park region as compared with that of Iceland and New Zealand.

The chemical investigation of the Yellowstone springs is not yet sufficiently complete for their satisfactory classification; but they are broadly divided by Dr. Peale into those of calcareous, siliceous, and aluminous character. The so-called aluminous springs, being those highly charged with mud, or matter in a state of suspension, will doubtless eventually be relegated to one or other of the first-named classes. The possible therapeutical value of the springs is as yet practically untested; and it is to be remarked in this connection, that the climate is such as in any event to be unfavorable to those suffering from debilitating diseases. A few experiments on the color of the waters are recorded; but these, it must be confessed, are unsatisfactory, as the samples had been long in bottle; and, apart from this, it is doubtful whether the waters of the park offer peculiarities so marked as to throw any important light on a subject which has already been elaborately studied by physicists and chemists.

The older theory of geyser action requiring a steam-chamber which blew off, from time to time, through a water-trap connecting with a tubular orifice, and implying a quite exceptional co-ordination of circumstances, became virtually untenable when geysers were discovered in such considerable numbers in different regions. Bunsen's explanation, depending on the superheating of water under pressure in fissures, or more or less tubular receptacles, seriously modified in action by local circumstances, is considered sufficient to account for the observed phenomena.

Appended to this report, is a valuable bibliography of the park, and of the literature treating of geysers and hot-springs generally.

In the latter part of the volume, Mr. Gannett reviews the geographical work on which the excellent maps accompanying the report are based.

Notwithstanding the amount of precise information now made available on this region, much yet evidently remains to be discovered. The field-work on which the report on the park is based extended over about two months only; and the observations have too often been of what Mr. Holmes regretfully describes as the 'twenty-five-mile-a-day kind.' Armed with the present report, embodying the results so far obtained, each scientific visitor for a long time to come may well hope to add some important new facts. The definition of the catchment areas from which the various groups of springs are supplied, and the circulation of the underground waters, may be specially noted as an important point scarcely yet touched.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Princeton science club.

Nov. 8. — Dr. L. W. McCay reported that the Perrot method for estimating P_2O_5 can only give accurate results providing chlorine be absent. This, however, is seldom the case in apatites, superphosphates, etc. He therefore proposes a modification, — dissolving the tri-argentic phosphate from the filter-paper with dilute nitric acid, thereby leaving the chloride, and proceeding at once to titrate the silver according to Vallhardt. He reserves for himself the privilege of developing the subject.

Jan. 10. — Dr. Halsted opened a discussion as to whether Euclid was a suitable text-book for elementary geometrical instruction; — Mr. Fine read a paper on Synthetic solution of a class of problems in maxima and minima on the partition of a segment of a circle; — Professor Macloskie, Notes on biological articles in recent scientific serials; — Dr. McCay, Analysis of beer made in state of New Jersey; — Mr. McNeill, Determination of co-ordinates of certain stars by the meridian circle; — Professor Scott, The lamprey (the peculiar flattened shape of the spinal cord in the lamprey arises late in larval life, and is an acquired peculiarity. In the embryo the dorsal roots of the spinal nerves are all connected by a commissure, which also connects the tenth, ninth, and seventh nerves together, and with the spinal nerves. This commissure apparently forms the lateral nerve. The third nerve arises independently, and would seem to be of segmental value); — Professor Osborn, A method of double injection of anatomical specimens (by first injecting the veins through the arteries with blue gelatine, then injecting the arteries with plaster of paris, which is stopped at the capillaries, the veins and arteries can be readily distinguished); — Professor Young, The cause of the unusual sunsets, On the spectrum of the Pons-Brooks comet.

Ottawa field-naturalists' club.

Jan. 17. — The paper of the evening was by Mr. E. Odlum, M.A., of Pembroke, 'On the sand-plains and changes of water-level of the Upper Ottawa;' the portion of the river specially referred to being a stretch of some forty miles opposite the town of Pembroke, and extending from the head of the Coulonge Lake to the entrance of the reach known as the Deep

River. The district thus included lies along latitude 45° 50′, between longitudes 76° 40′ and 77° 40′; the town of Pembroke being 77° 10′, with an elevation above sea-level of 423 feet. At the upper end of the district the Ottawa divides its waters, and encircles the large Allumette Island; the Culbute Channel on the north being narrow, while the southern one expands so as to be known as the Upper and Lower Allumette Lakes. On the Quebec shore the land rises precipitously; the Laurentian Mountains seldom receding more than a mile, and at times rising sheer from the water's edge in towering cliffs of trap. On the Ontario side the land is comparatively undulating, and rises by a succession of plateaus separated by ridges of rock, or by ranges of hills gradually increasing in height. After a graphic description of the beauties of this district, the writer outlined the principal sand-plains which constitute a large portion of the steppes of the southern shore, and pointed out that their levels coincided with the well-marked terraces found on Allumette Island and at other points along the river. The formation of these sand-plains was then fully discussed; and it was claimed that they had undoubtedly been formed from the *débris* transported by flowing water from the rock ranges that bound and intersect them, and toward which the surface gradually changes from fine sand (or occasionally clay), through coarser sands, pebbles, etc., to bowlders. The principal plain is that called the Chalk-river sand-plain, extending from near Pembroke, twenty miles westward. It is interrupted toward the lower end by broken ridges, which harmonize in position with the rapids, and which formed parts of barriers between a higher level westward and a lower level eastward. Occasional sand-ridges occur, which lie between the ancient mouths of rivers, of which some are now extinct, and others, as the Petawawa and Muskrat, still flow in greatly diminished volume. The two principal levels of this plain correspond with two terraces boldly marked on the Laurentians near the head of Coulonge Lake, fully thirty miles away. A lake as large as, or larger than, Superior must in the past have hidden in its great depths Allumette Island, the entire Pembroke district, and adjacent sand-plains, as well as thousands of the now arable acres lying toward Renfrew. As indicated by the terraces, there had been two distinct periods, in the first of which the water had been 200 feet deeper, and in the second 100 feet deeper, than the present level. After describing the constitution of the soils derived respectively from the granite or trap ridges, and their relative capacities for agriculture, the writer very lucidly and interestingly explained the changes, as witnessed by him, which are still going on in the district, and the manner in which, by the incessant weathering and denudation of the rocks, sand-plains on a smaller scale are still being formed. The present barriers which cause the rapids interrupting navigation were explained to be of varying degrees of hardness, so that change proceeds more rapidly at certain points. Thus the channel rocks at the foot of the river-reach in question are composed of fine sandstones (Potsdam) compacted with bluish clay, and are being rapidly eroded; and at a not excessively remote date the channel will be so lowered that the upper and lower lakes will form one navigable level, while the channel to the west, having a much harder bed-rock, will be changed to impassable rapids by the subsidence of the lake below them. Reference was made to various older channels which evidenced former higher levels which the existence of terraces and undoubted water-lines fully confirmed. In the discussion that ensued, several members who had visited the locality and other portions of the Upper Ottawa gave evidence as to the existence of numerous traces of old water-currents at points now much above the present levels.

Mr. H. M. Ami presented a list of the Cambro-silurian fossils of the neighborhood, containing 228 species, and prefaced by a few notes as to its compilation. The report of the geological section on the summer's work was also read, and the president announced that classes in botany and zoölogy would be held weekly.

Franklin institute, Philadelphia.

Jan. 16. — The annual report of Board of managers exhibited the addition of a hundred and thirty-nine new members during 1883, and of over three thousand volumes to the library. Preparations for the Electrical exhibition, to be held during the autumn of 1884, are in an advanced state. A national conference of electricians is in contemplation. The subject of a "Proposed ordinance for the examination of steam-engineers" was warmly debated, *pro* and *con*, but no decisive action was taken. Mr. S. Lloyd Wiegand read a paper defending the use of cast iron in the construction of steam-boilers, it having been alleged by Nystrom and others that steam-boilers with flat cast-iron heads were dangerous. The secretary's report embraced a summary of engineering and industrial progress for the past year.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

The U.S. naval observatory.

Vice-Admiral Stephen C. Rowan was appointed July 1, 1882, to succeed Rear-Admiral John Rodgers as superintendent of the observatory. On May 1, 1883, Vice-Admiral Rowan was relieved by Rear-Admiral R. W. Shufeldt. The report of Admiral Shufeldt to Commodore J. G. Walker, chief of bureau of navigation, under date of Oct. 22, 1883, covers the work of the observatory for the past year.

The *personnel* of the observatory is as follows: —

Rear-Admiral R. W. Shufeldt, superintendent; Commander W. T. Sampson, assistant to superintendent; lieutenants, Pendleton, Moore, Bowman, Gar-

vin, Wilson, Harris, Sewell; ensigns, Brown,[1] Allen, Taylor, Hoogewerff; professors, Hall, Harkness, Eastman, Frisby; assistant astronomers, Skinner, Winlock, Paul; clerk, Thomas Harrison; computer, W. M. Brown, jun.; computers (transit of Venus), Woodward, Flint, Wiessner, A. Hall, jun.; instrument-maker, W. F. Gardner; also three watchmen and nine laborers.

The report, which is not yet published, contains a brief account of the work accomplished with the principal instruments of the observatory, — the 26-inch and 9.6-inch equatorials, the transit circle, prime vertical and meridian transit, — and the progress in the chronometer department, the department of nautical instruments, the library, and also in the reductions of Gilliss's Zones of 1850, 1851, 1852.

The 26-inch equatorial. — This instrument has been in charge of Prof. A. Hall, with Prof. E. Frisby as assistant. Mr. George Anderson is employed as an assistant in the dome. The canvas covering for the opening of the dome is still used, and a change in the raising and lowering of this covering has been made in order to avoid the friction of the wire ropes. Thus far the new arrangement has worked well. This equatorial has been employed, as in preceding years, for the observation of double stars, satellites, and comets. The satellites of Saturn, Uranus, and Neptune have been observed; and we have now collected a large number of observations of these satellites. The ring of Saturn has been observed, but no remarkable changes have been noticed. In fact, many of the strange phenomena frequently described in connection with this unique ring, the observers here fail to see on the best nights. During the greatest opening of the ring, which is near at hand, it is intended to make a set of micrometric measures of the dimensions of the ring. Some observations for stellar parallax have been undertaken; but, as the observer resides at some distance from the observatory, such work is very laborious, and it seems better to defer it until more convenient arrangements are made. At the present time the pressing need on this instrument is, that the observations of satellites already made should be discussed for the purpose of correcting the orbits of these satellites, and of determining the masses of the planets. This discussion has been begun, and the numerical calculations are being made by Ensigns W. H. Allen and J. A. Hoogewerff.

The transit circle. — This instrument, in charge of Prof. J. R. Eastman, was employed in the same class of work as in 1881–82. The observers were Professor Eastman, and Assistant astronomers A. N. Skinner, Miles Rock,[2] and W. C. Winlock. Professor Eastman was absent, in charge of a transit of Venus party at Cedar Keyes, Florida, from Nov. 1, 1882, to Jan. 1, 1883. Assistant astronomer Miles Rock, who was detached in September, 1882, for duty with the transit of Venus party at Santiago, Chile, was away until Feb. 10, 1883. The whole number of observations made with the transit circle from Oct. 18, 1882, to Oct. 18, 1883, is 3,880.

[1] Appointed professor of mathematics, U.S.N., Oct. 13, 1883.
[2] Succeeded, Nov. 1, 1883, by Prof. H. M. Paul.

The meteorological observations have been continued, as in former years, by the watchmen.

The 9.6-inch equatorial. — This instrument has been in charge of Commander W. T. Sampson, assisted part of the time by Lieut. W. E. Sewell, and part of the time by Lieut. John Garvin. It has been used, as in former years, in observations of the phenomena of Jupiter's satellites, occultations by the moon, places of comets, and for obtaining corrections to the ephemeris places of minor planets.

Prime vertical instrument. — This instrument is in charge of Lieut. C. G. Bowman, assisted by Ensign H. Taylor. Observations with it were recommenced Nov. 14, 1882. Continuous observations have been restricted to about forty stars, in no case exceeding 2° zenith distance when on the meridian; and these, with one exception, have been closely confined to the time of the two maxima of aberration. The one exception referred to was in the case of α Lyrae, which has been regularly observed throughout the twenty-four hours, having in view the possibility of a determination of its absolute parallax. Up to this time about five hundred and eighty observations have been secured. In the reductions, Struve's formulae have been used; and the labor has been greatly lessened by the use of his auxiliary tables for the prime vertical transit.

Meridian transit instrument. — This instrument has been in charge of Lieut. U. R. Harris, and Lieut. E. C. Pendleton has assisted. Since July 10, Lieuts. Pendleton and Harris have alternated in determining the correction of the standard mean-time clock. The meridian transit instrument has been used for the observations of stars of the *American ephemeris* for clock and azimuth corrections, and the determinations of the right ascensions of the sun, moon, and major planets. The total number of observations of the character mentioned is fourteen hundred and eight. Observations have been taken as often as practicable, to obtain each day the correction of the standard mean-time clock for setting to correct time the transmitting clock, which is used in sending out the time-signals from the chronometer-room, and in rating the chronometers.

National museum.

Publications. — Volume 5 of the 'Proceedings of the National museum' has just been issued from the Government printing-office. It contains 703 pages, and includes 87 articles by 34 authors, grouped topically as follows: mammals, 4; birds, 21; reptiles, 2; fishes, 48; mollusks, 3; crustaceans, 1; insects, etc., 2; plants, fossil and recent, 4; minerals and rocks, 2; art and industry, 1.

Catlin Indian paintings. — The Catlin collection of Indian paintings recently given to the museum by Mrs. Joseph Harrison of Philadelphia, is now being prepared for exhibition. This collection consists of over six hundred paintings, chiefly portraits and delineations of ceremonies, games, and hunting-scenes, made by the artist during eight years' residence in the western territories, Mexico, and British North America, previous to 1840. It contains authenticated

portraits of three hundred and fifty men and women, and over three thousand figures of Indians of the tribes known as Sacs, Foxes, Konzas, Osages, Comanches, Pawnees, Kiowas, Sioux, Omahas, Missouries, Mandans, Flatheads, Blackfeet, Crows, Gros Ventres, Crees, Assineboins, Chippewas, Iroquois, Ottawas, Winnebagoes, and twenty-seven other tribes. Its value as a record of ethnological characters is inestimable.

There were two collections, — one consisting of the original paintings done in the field, exhibited by Mr. Catlin for many years in Europe; the other, copies made at a later date, which was exhibited in the old Smithsonian building many years ago, and now the property of Mr. Catlin's heirs. The collection given to the museum is the original one, and is regarded by artists and ethnologists as by far the most valuable. The pictures, which have been for fifteen years stored away in a warehouse in Philadelphia, are in a remarkably good state of preservation.

There are also on exhibition five paintings by Stanley, — all that remains of the Stanley collection of Indian paintings destroyed by the fire in the Smithsonian building in 1865.

Naval officers in the museum. — In continuance of the policy adopted two years ago, the secretary of the navy has detailed six more ensigns to duty in the museum. These are graduates of the Naval academy in the classes of 1877–79, who have just finished their first three years' cruise, and will now give two years to scientific work under the direction of the officers of the museum. Mr. C. S. McClain has been assigned to the department of marine invertebrates; Mr. C. H. Harlow, to that of arts and industries; Mr. H. M. Witzul, to metallurgy; Mr. H. S. Knapp and Mr. O. G. Dodge, to mineralogy.

Department of mineralogy. — Prof. F. W. Clarke, chemist of the Geological survey, has been appointed honorary curator of minerals, and is preparing a series of minerals for exhibition. Mr. W. S. Yeates, aid in the museum, who has been in temporary charge of the minerals since the death of Dr. Hawes, the former curator, is acting as assistant in this department.

Mr. Joseph Willcox of Philadelphia has deposited his collection of American minerals in the museum, and one thousand of the choicest specimens have been placed on exhibition.

Foods and textiles. — Mr. Romyn Hitchcock is acting as assistant curator, having in charge the collections of foods and textiles. The collection is very rich in the textile products of the Indians, and has considerable quantities of food-materials acquired from foreign governments at the close of the Philadelphia exhibition.

Explorations in Corea. — Mr. Pierre L. Jouy, of the museum staff, is attached to the American embassy in Corea, and is making zoölogical explorations. Ensign J. C. Bernadou, U.S.N., has sailed for Corea, to spend two years in ethnological and mineralogical explorations. Mr. Bernadou was one of the officers detailed to duty at the museum last year.

Voyage of the Albatross. — The steamer Albatross sailed from Norfolk, Jan. 8, for a four-months' cruise in the Caribbean Sea, in the service of the hydrographic office of the navy. She is under command of Lieut. Z. L. Tanner, and carries a special staff of zoölogical workers, including Mr. J. E. Benedict, naturalist in charge; Mr. Willard Nye, jun.; and Ensigns Miner, Garrett, and Ackerman, U.S.N., of the museum staff.

Mammal department. — Mr. Frederick W. True, curator of mammals, is in England, studying methods of investigation and museum administration with Professor Flower, at the Royal college of surgeons in London.

Foraminifera. — Prof. L. A. Lee of Bowdoin college was in Washington, Jan. 3 to Jan. 8, studying the museum collections of foraminifera with reference to his investigations upon the materials obtained by the Fish commission.

Director's office. — During the reconstruction of the east end of the Smithsonian building, Professor Baird is occupying an office in the north-west pavilion of the museum.

NOTES AND NEWS.

ALL the parties sent out by the various governments at the suggestion of the International polar commission have returned home safely, and with valuable meteorological and magnetic records, with the exception of three. The Russian station at the mouth of the Lena will continue its work for another year, on account of delay from storms in reaching its destination. The Finnish, at Sodankyla, although it has finished one good year's work, will continue for another, as the government of Finland has supplied the necessary funds. The misfortunes of the Greely party are too well known.

— The first number of the *Auk*, published under the auspices of the newly organized American ornithologists' union, closely resembles the Bulletin of the Nuttall club, of which it is the continuation, and bids fair to be a credit to American ornithologists. An excellent colored plate forms a frontispiece to the number, and the articles are varied and interesting. One would perhaps justly complain of the space given to disputes over words, and lament the entire absence of papers upon either the anatomy or the general structure of birds, but these are perhaps to come in future numbers; and there is a pleasant flavor of careful out-door observation running through some of the papers, such as those of Messrs. Brewster, Barrows, and Bicknell. The effect of the formation of the union four months ago, is already seen in the plan offered by the committee charged with the subject for co-operative work in the study of bird-migration on this continent. We think a brief account of the formation and purpose of the union would have been a fitting introduction to the number.

— Professor F. M. Snow of the University of Kansas, from observations taken at Lawrence, reports that only three Decembers in the past sixteen years have been milder than that just passed, — 1875, 1877,

and 1881. There were very few days during the month in which building operations were not actively pushed. The sky was clearer, the wind was higher, and the rainfall was more than fifty per cent smaller, than the December average. The remarkable prolonged crimson and orange sunset glow, which was observed in the last week of November, continued with a somewhat intermittent brilliancy during the month of December.

—We take the following personal notes from *Nature*:—

Prof. W. H. Macintosh has been elected to the professorship of comparative anatomy in Trinity college, Dublin, *vice* Professor Macalister, F.R.S., who resigned on his appointment to the anatomy chair at Cambridge. —— By the death of the well-known mathematician, the Rev. W. Roberts, M.A., the Rev. Richard Townsend, M.A., F.R.S., becomes a senior fellow of Trinity college, Dublin, thereby vacating the professorship of natural philosophy held by him since 1870. ——The vacancy in the professorship of geology and mineralogy, in the University of Dublin, has been filled by the election of Professor Sollas of University college, Bristol. This appointment will give great satisfaction, and will afford Mr. Sollas large opportunities for paleontological research; the large collections of fossil plants and vertebrates in the museum in Dublin remaining to this day almost unknown. —— M. Houzeau, who was only recently appointed director of the Brussels observatory, has resigned his post; and it is reported that M. de Konkolly of Gzalla observatory, Hungary, will succeed him.

—The Swedish government intends to establish a botanico-physiological station in the north of Sweden for the study of the flora and the diseases of the crops in that part of the country.

—The Finnish government has ordered a steamer to be specially built in Sweden for the scientific researches about to be prosecuted in the Baltic.

—Lord Rayleigh has reprinted for private circulation, in pamphlet form, several of his most valuable optical papers, including those on the manufacture, reproduction by photography, and theory, of diffraction-gratings, and those on color-mixtures. He has also reprinted some of his papers on electricity and on absolute pitch, from *Nature* and from the reports of the British association, in a convenient pamphlet form.

—At its annual meeting, Jan. 11, the Cambridge entomological club elected the following officers: president, Samuel H. Scudder; secretary, George Dimmock; treasurer, B. P. Mann; librarian, C. C. Eaton; executive committee, Roland Hayward and T. W. Harris.

—Prof. H. Carvill Lewis, of the Academy of natural sciences of Philadelphia, has been appointed lecturer on geology and paleontology at Haverford college, Pennsylvania.

—A dissertation on the 'Proper names of Panjabis,' with special reference to the proper names of villagers in the eastern Panjab, by Capt. R. C. Temple, Bengal staff corps, contains a study of the proper names of the peoples of the Panjab. The book contains, also, long lists of names, showing by what classes of the population the various kinds of them are used, and is provided with an index to over four thousand proper names. The book is published at the Education society's press, Bombay, and by Messrs. Thacker Spink & Co. in Calcutta, and Messrs. Trübner & Co., Ludgate Hill, London.

—Sampson, Low, & Co. announce 'Heath's fern portfolio,'—a series of life-size reproductions of ferns, being in form, color, and venation, accurate representations. The work is to be published in monthly parts.

—The *Publishers' weekly* announces that Rev. A. B. Hervey of Taunton, Mass., has translated Dr. Behren's book on methods of conducting microscopical investigations in the botanical laboratory. He has enhanced the value of the translation by adding the methods of work used in this country.

—Cupples, Upham, & Co., Boston, have ready 'The amphitheatres of ancient Rome,' by Clara L. Wells.

—Schuver, during recent explorations in the Galla country, purchased from them a young negro of a race called Gambil, from whom he obtained interesting details in regard to his people. It appears, from his account in the *Revue géographique*, that the Gambils live on the Komonshi River, an affluent from the right bank of the Sobat,—a name which signifies Cow River, because in the dry season their numerous herds find forage only along its banks. Ostriches and elephants abound. They have a tree which bears a fruit two feet long, weighing ten or twelve pounds, which is softened in water, dried, and eaten. The principal village is Komonshok; but some thirty others were named by this negro, among them Kepil, which is a market where iron, copper, and beads are bought by the Gambils from the Gallas. They eat fowls and eggs, which the Gallas abominate, and raise pigs. They break out the two lower incisors, and wear two little horns of the gazelle or goat on the forehead. Some years since, they were attacked by the Denkas, who almost destroyed the tribe; many of whom, for safety, offered themselves as voluntary slaves to the Lega Gallas.

—At the November meeting of the London society of biblical archaeology, Mr. Pinches read a paper on Babylonian art, as illustrated by Mr. Rassam's latest discoveries. Among the discoveries on the site of the ancient Sippar, Mr. Pinches considers the most important to be a "small egg-shaped object of beautifully veined marble, pierced lengthwise with a rather large hole, and engraved with an inscription of seven lines (two double) containing the name of Sargon of Agade (3800 B.C.)."

Another small object, made of a dark-green stone in a bronze socket engraved or cast in the shape of a

ram's head, bears an inscription stating that it was presented to Samas, the sun-god, by a king of Hana. From the character of the writing, Mr. Pinches places the date of the relic at about 850 B.C., and draws from the fact that it was presented by a foreign king the conclusion that the shrine of the sun-god at Sippar must have attained to great renown.

Another most interesting object of about the date 685 B.C. is a lion's head carved in white limestone, perhaps originally forming a part of some piece of furniture. "The mouth, which was opened threateningly, showed the well-formed teeth. Above the upper lip were, on each side, five curved, sunken grooves, which were formerly inlaid with some material, probably to enable the long feelers or whiskers to be inserted. Wavy grooves for inlaying were also to be seen above the nose. The eyes were inlaid, and the holes for the insertion of the long hairs forming the eyebrows still remained. In the middle of the forehead there had originally been inserted the little winged figure emblematic of the god Assur." The accompanying inscription contains the names of the Assyrian kings Sennacherib and Esarhaddon.

Among other objects mentioned were statues of the sun-god and his attendant deities, all clothed in long robes. The reader pointed out that the specimens of art found by M. Sarzec at Tel-lo are finer than those found by Rassam at Sippar; the former coming from the more polished Akkadian, the latter from the more powerful but less refined Semite.

— The domestication of the ostrich in South Africa is of only some fifteen years standing, all previous product of plumes being due to hunting. At first there was much opposition to the proposal; and it was fancied that the plumes of domesticated birds would prove of inferior quality, which has not turned out to be the case. In 1865 there were only eighty, but in 1883 there are more than a hundred thousand tame ostriches. They have even been introduced into California. In 1880 forty millions of capital was engaged in the business, and a hundred and sixty-three thousand pounds of feathers were exported from the Cape, worth nearly $4,200,000. The birds are kept in enclosures, which, in a natural state, must be twenty or thirty acres in extent per pair. When the area is diminished, they must be supplied with food. They begin to breed at the age of four years, but produce plumes after their first year. The plumes are cut or pulled out. In the latter case injuries sometimes result, both to birds and manipulators; so that the former process is preferred, although after six weeks it is necessary to remove the withered remains of the shaft. The feathers are classed according to their character; as, wing feathers (white), female feathers (white), tail feathers, fancy feathers (black and white), black feathers (long, medium, and short), and lastly gray feathers. Formerly the Cape plumes took only the sixth rank after those from Aleppo, Barbary, Senegal, Egypt, and Mogador, valued in the above-mentioned order. Now, however, the Cape plumes are ranked as high as any. The largest exportation is from Port Elizabeth. England is the great market, followed by France. New York is lately taking an important place in the trade. The value of the feathers has diminished one-third under the increase of production, but the cost of the birds has also diminished. A pair of breeders has been sold within two years for twelve hundred dollars; but at present a pair can be had for two hundred to two hundred and fifty dollars. Under good conditions, a bird produces fifty dollars' worth of plumes per annum, to which must be added the value of the eggs and chicks.

— The Catholic missionaries who have recently established themselves among the Massanzé on the west of Lake Tanganyika are meeting with a good deal of success. The men of the district, great travellers, speak mostly a jargon of several languages. Their own tongue is only heard in purity from the women, by whose aid a grammar and vocabulary have been prepared. An excitement was recently caused by one of the whites cobbling a shoe over an iron last. The natives took this for an actual white man's foot which had been cut off; and one of the missionaries was obliged to take off his foot-gear to satisfy them that white men had toes. The Uambembé, reputed cannibals of the adjacent mountains, who have never suffered any whites to enter their territory before, have welcomed the missionaries, and offered them sites for residence in the villages of the three principal chiefs. This mission-station will be re-enforced very shortly.

— The Stirling Castle, constructed at Glasgow especially for the China trade, during the past season has brought from Woosung to London a cargo of tea in thirty-one days. This is four days shorter than the best previous record. The vessel is supplied with engines of eighty-five hundred horse power, and maintained a perfectly regular speed of eighteen knots throughout the journey.

— In view of the constantly increasing number of meteorological stations in Russia, Rikacheff, vice-director of the Central physical observatory, has undertaken a careful verification of the instruments, methods, and conditions at the different stations.

— A. Roberjot, of the French navy, gives, in the *Bulletin* of the French society of geography, the results of a voyage in 1879 among the New Hebrides, and accompanies them by a small chart and several woodcuts in the text. The naval vessel Second sailed from Noumea, New Caledonia, and touched at various islands, beginning at the south-east with Annatom, and ending with Espiritu Santo to the north-west. Numerous interesting facts in regard to the present condition of the natives, some short lists of words and details in regard to the character of the several islands, are given, and form a useful contribution to our knowledge of a people who are rapidly changing under the influences of missionaries, civilization, and the so-called 'labor-trade,' which appears to be a kind of slavery into which the chiefs sell their unresisting people.